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Preparation of necessary documents for establishing of an Integrated and Financially Self-sustainable Waste Management System in Pelagonija, Southwest, Vardar and Skopje Regions

Feasibility Study & CBA

Skopje Region

(10/112017)

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A project implemented by ENVIROPLAN SA and its consortium partners

ENVIROPLAN S.A. (Leader) – LOUIS BERGER – BiPRO GmbH – EPEM S.A. – SLR Consulting Limited
23 Perikleous Str.
15344 Gerakas/Athens - Greece
Tel: +30 210 6105127 / 8
Fax: +30 210 6105138
Email: fl@enviroplan.gr

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Drafted by:	Christos Tsompanidis, Team Leader
	Eleni Ieremiadi-Waste Management/Feasibility Expert
	Krystallia Oikonomou-Financial Expert (CBA)
	Georgia Louka-SWM design/Procurement Expert
Checked by:	Christos Tsompanidis, Team Leader
Approved by:	Theofanis Lolos, Project Director

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1. EXECUTIVE SUMMARY

1.1 INTRODUCTION

The overall objective of the project "Preparation of necessary documents for establishing of an Integrated and Financially Self-Sustainable Waste Management System in Pelagonija, Southwest, Vardar and Skopje Regions" is to achieve an integrated and financially self-sustainable waste management system in those Regions.

The project's purpose is the preparation of Regional Waste Management Plans and Strategic Environmental Assessments, as well as preparation of Feasibility Studies, Cost-Benefit Analyses, Environmental Impact Assessment, Detailed Designs and assistance with preparation of Volume 3, 4 and 5 of the Tender Dossiers for works and supply contracts for construction of selected waste treatment and disposal facilities, closure of noncompliance landfills/dumpsites and for supply of equipment for waste collection and transferring of waste according to the EU standards for Pelagonija, Southwest, Vardar and Skopje Regions. There are nine (9) components to this project and the purpose of the present report is Component 3: the preparation of the Feasibility Studies for establishing of an Integrated and Financially Self-Sustainable Waste Management System for each of the four Regions.

Regarding the project's context within the national waste management policy, currently the municipal waste management in the beneficiary country is undergoing a radical transformation from decentralized disposal of non-treated waste on numerous local sub-standard landfills within Regions to centralized waste management facilities serving needs of one Region or, in some cases, of several Regions. The Central Waste Management Facilities concept has been adopted by the beneficiary country in its National Waste Management Plan.The Feasibility study for Skopje waste management region, demonstrates the way to select of the most acceptable taking into consideration the technical - technological, and financial - economic aspects, and is the basis for all technical solution and associated project documentation (preliminary and final design, documentation for the implementation of procedures for environmental impact assessment and documentation for the impact assessment procedure) for all facilities and equipment needed for the implementation of an integrated waste management system.

For the implementation of the feasibility study the following chapters were prepared:

- *Chapter 1: Executive Summary*. This chapter (present chapter) includes the summary of each chapter of the feasibility study taking into consideration the main conclusions, assumptions, methodologies and data used.
- *Chapter 2: Background Information and Review of the ExistingWaste Management System.* This chapter includes background information summarizing and presenting key points of previous reports for the region: Assessment Report, Waste Management Report, AdHoc Report. It describes the project location regarding its environmental and infrastructure aspects,it provides an overview of current collection and treatment system, current waste generation and management, recycling and recovery industry in usage and existing waste management system costs. Finally, this chapter identifies the regional possibilities for disposal for different products of CWMF.

- *Chapter 3: Socio Economic Context of the Project*. This chapter includes the current status and future projections regarding demographics, the current status and future projections regarding tourism, the current status and future status regarding affordability and economic aspects.
- *Chapter 4: Waste Content and Future Generation Forecast.* This chapter includes morphological composition of the mixed municipal waste, future waste generation and its content.
- *Chapter 5: Legal and Regulatory Framework*. This chapter includes EU waste management policy and directives, national policy and institutional framework, local spatial policy, the implications of the legal and policy issues on the project as well as available sources of financing.
- *Chapter 6:* Option Analysis. This chapter includes option analysis regarding collection system, locations and technologies for Transfer Stations.
- *Chapter 7: Proposed Investment Project*. This chapter describes the future waste management system from operational and technological point of view including an analysis of existing dumpsites and non compliant landfills in the region. This chapter describes the human resources and the promoter organization and provides detail CAPEX, OPEX and re-investment costs analysis.
- *Chapter 8: Environmental and Social Assessment*. This chapter includes all relevant information from the Environmental Impact Assessment and also includes a CO_2 footprint calculation (including without/with project scenario) and a report in climate change adaptation/resilience.
- Chapter 9: Financial and Economic Analysis. This Chapter represents the Cost Benefit Analysis of the *proposed waste management system and includes risk analysis.*
- Chapter 10: Procurement and Implementation. This chapter provides the procurement strategy and purpose of future contract arrangements and also provides detail project implementation plan.

1.2 BACKGROUND INFORMATION AND REVIEW OF THE EXISTING WASTE MANAGEMENT SYSTEM

The main objectives of chapter 2 (Background Information and Review of the Existing Waste Management System) are the following:

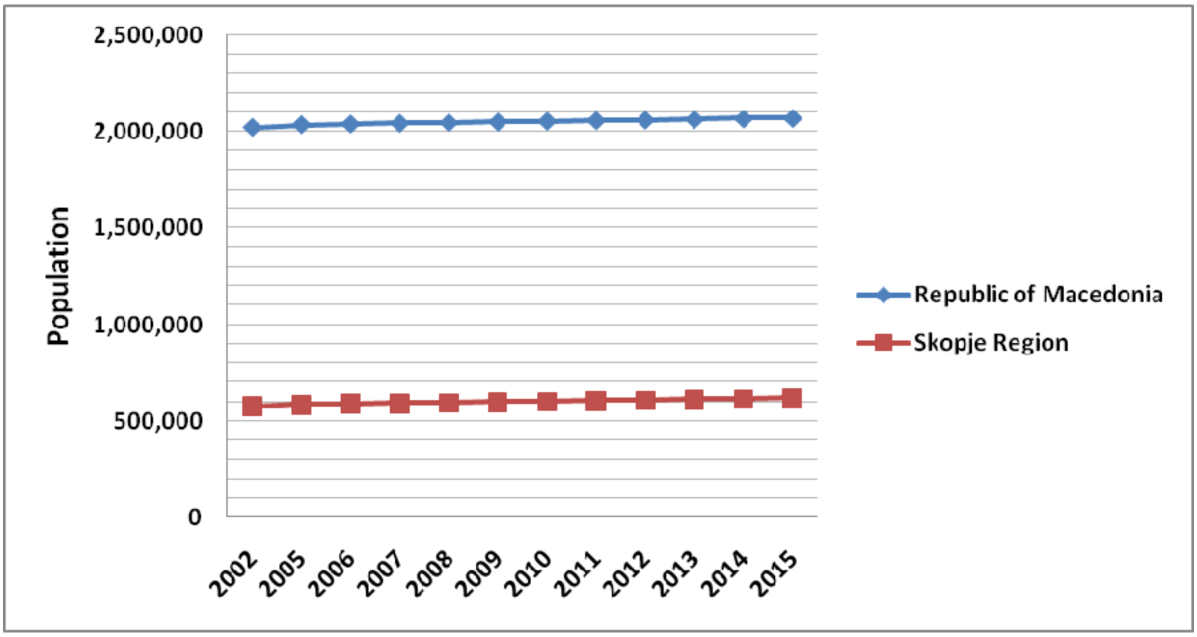
- Study and project background in the context of national waste management strategy and objectives. This paragraph describes an overall project objective and especially of the currentreport.
- Project location description. This paragraph describes the selected area of the present study.
- Environmental and infrastructure aspects. This paragraph includes a brief description of the environmental and infrastructure aspects of the future CWMF area, a brief description of the geological and hydrogeological characteristics, seismological activity, hydrology, landscape and climate characteristics, proximity to protected areas and site availability for the specific site and surrounding area.
- Current waste collection and treatment system overview. This paragraph includes informationregarding organizational aspects, collection coverage, waste collection and transportationequipment. This information is presented for the whole region and is described in detail in theAssessment Report of the region.
- Current waste streams overview, waste generation and management. This paragraph presents theresults Survey of existing non compliant landfills that consists the Part B of Assessment Report ofthe Region. Additionally, this paragraph provides information on the key problems in the currentwaste management system, identified through questionnaires. Finally, an overview of thegenerated solid municipal waste per municipality of the region.

- Recycling and recovery industry in usage. This paragraph presents the recycling companies, ifexisting.
- Existing waste management system costs. In this paragraph, the cost and unit costs for collectionand disposal per municipality of the region are presented.
- Identification of regional possibilities for disposal for different products of CWMF. This paragraphpresents the potential uses of the main outlets RDF/SRF, the marketability of CLO, compost andrecyclables.

1.3 SOCIO-ECONOMIC CONTEXT OF THE PROJECT

The main objectives of chapter 3 (Socio economic context of the project) are the following:

- Permanent population-current status and future projections. This paragraph presents data regarding the population for the county according to Census 2002 and estimations for 2015 (State Statistical Office of the Republic of Macedonia) as well as a division in urban and rural population. The future projection of the permanent population until year 2046was calculated by the project team and the average annual rate of change of urban and rural population is given according to World Bank data. The following table presents an overview of current status and future permanentpopulation estimations according to the selected variant.



- Seasonal population - current status and future projections. This paragraph includes data regarding the seasonal population for the county

Municipalities (Skopje Region)	NumberofNightsSpent2014(SourceStateStatistical officeof the RM)	Number of NightsSpent2015(SourceState Statistical officeof the RM)
City ofSkopje	390,798	452,912
Aerodrom	-	-
Butel	-	-
GaziBaba	-	-
Gjorche Petrov	-	-
Karposh	62,819	86,224
KiselaVoda	8,952	6,954
Chair	22,448	50,029
Centar	175,256	184,420
Shuto Orizari	0	0
Saraj	-	-
Arachinovo	0	0
Zelenikovo	0	0
Ilinden	0	0
Petrovets	0	0
Studenichani	0	0
Sopishte	0	0
ChucherSandevo	0	0
Total	**390,798**	**452,912**

- Economic development aspects. This paragraph describes the Gross Domestic Product per capita for years 2010, 2011, 2012 and 2013 for Republic of Macedonia and for Skopje Region. GPD per capita in Skopje Region for year 2010 is higher than the average GDP per capita in the Republic of Macedonia.It also describes the available income by decile.
- The chapter also includes an analysis of Poverty and Payment indicators
- Current affordability. This paragraph includes calculations regarding the affordability level concerning the average annual income per household.
- Future economic development and affordability. This paragraph presents a brief description of thereal GDP growth and contributions in the beneficiary country.

1.4 WASTE CONTENT AND FUTURE GENERATION FORECAST

The main objectives of chapter 4 (Waste content and future generation forecast) are the following:

- Presentation of the methodology, the sampling procedure and results of Morphologicalcomposition analysis of the mixed municipal waste. The analysis was analytically presented in theAnnex II of the Assessment Report. The average waste composition in the region has beencalculated, and presented in the following table:

Fraction	Totalpresentence%
Gardenwaste	14.08%
Otherbiodegradable waste	28.19%
Paper	7.81%
Cardboard	5.84%
Glass	4.56%
Metals (ferrous)	1.06%
Aluminum(non-ferrous)	0.73%
Composite Materials	1.59%
Plasticpackagingwaste	4.32%
Plasticbags	7.81%
PETbottles	3.48%
Otherplastic	2.26%
Textile	5.45%
Leather	1.00%
Diapers	6.10%
Wood	0.64%
Construction and demolitionmaterial	1.72%
WEEE	0.41%
Hazardous materials (Medical waste)	0.24%
Otherspecialwaste streams (Elastic-tyres etc)	0.51%
Fine fraction(<10mm)	2.22%
Total	**100.00%**

- Future waste generation forecast. In order to calculate the future waste generation forecast, data from the quantitative waste analysis of the municipal solid waste were used.
- The future generated quantities divided in urban and rural of MSW have been calculated after the examination of four alternative scenarios regarding the Waste Generation Rate Growth. The scenario 2- low growth-in addition to population growth, per capita generation linked to 50% of growth in GDP, followed by 2% between years 2021-2030 was selected. The future municipal waste generation per municipality resulted from calculations of the project team until the year 2046. The following table summarizes the basic calculations of this chapter.

	2016	**2046**
Permanent Population	620,223	636,248
Quantity of produced Municipal Waste (t)	162,883	188,456
Waste production Rate for permanent population (kg/cap/year)	263	296

1.5 LEGAL AND REGULATORY FRAMEWORK

The main objectives of chapter 5 (Legal and Regulatory framework) are the following:

- EU waste management policy and directives. This paragraph describes the European Union directives that set out goals for reuse, recycling and recovery, collection and disposal for differentwaste categories (Municipal waste, batteries, WEEE).
- National policy and institutional framework. This paragraph provides an overview of the mainwaste management legal framework in the beneficiary country.
- Local spatial policy. This paragraph includes a description of waste management policy on countylevel, on local self-government unit level and a brief description of local spatial policy.
- Implications of the legal and policy issues on the project. This paragraph presents objectives that could be realized in the time period of this waste management plan 2009-2015 of the beneficiarycountry.
- Available sources of financing. The main possible sources of financing investments for the implementation of the EU waste legislation, for the execution of the variety of organizational and public relations tasks, and for elaboration of the necessary technical, spatial and investmentdocumentation and environmental studies and capital investments are described.

1.6 OPTION ANALYSIS

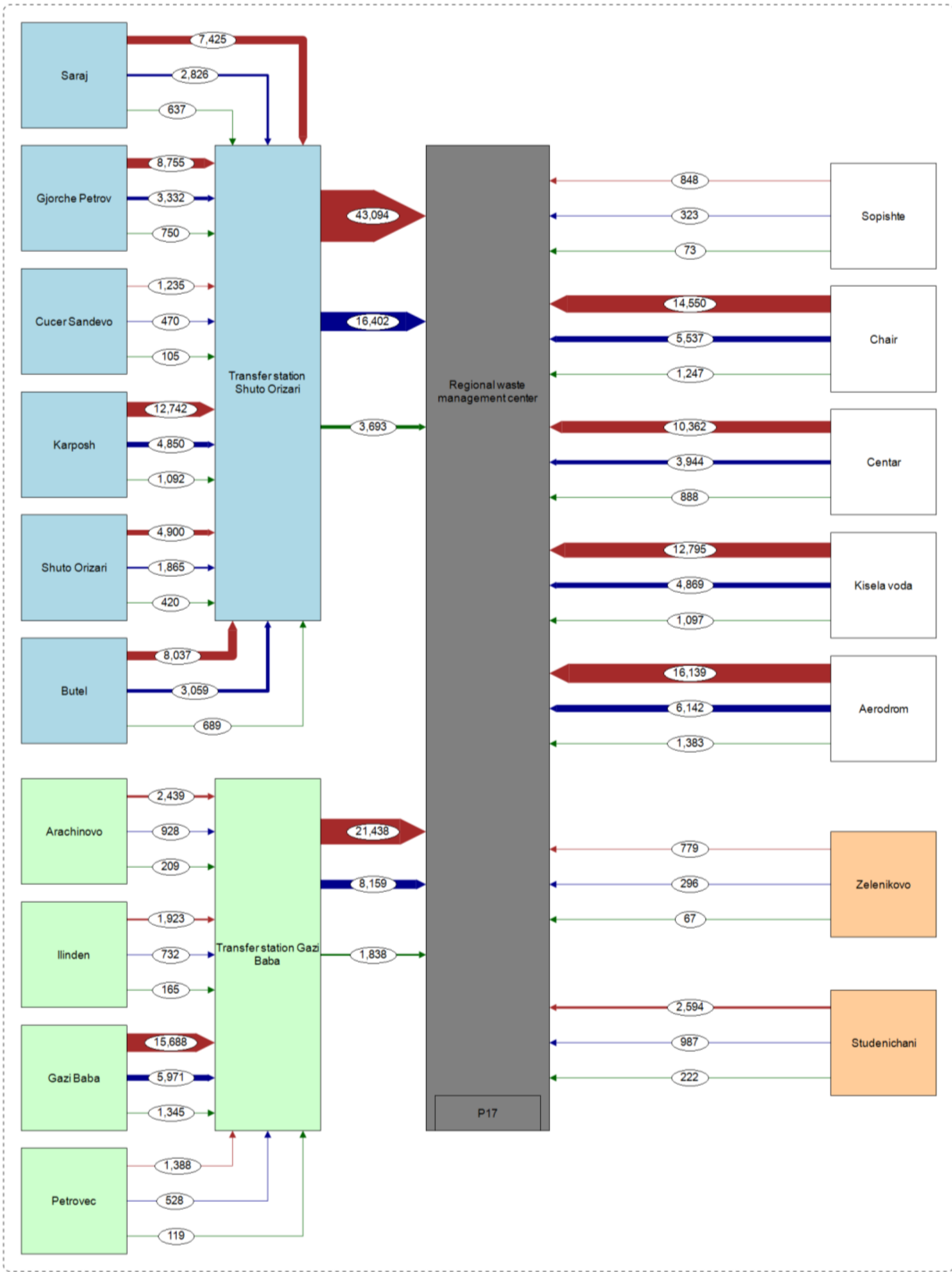
The main contents of chapter 6 (Option analysis) are the following:

- Methodology. Firstly this chapter presents the concept of Integrated Solid Waste Management (ISWM) and the methodology followed in order to create a municipal waste management system.
- Project determination and its objectives. The general and specific objectives of the project are presented, along with the targets that must be achieved by the proposed waste managementsystem in order to contribute to the beneficiary country's national targets.
- Option analysis for the location of TSs. The steps for the identification of the appropriate location of the Transfer Station areas are presented. Then, the three indentified areas for TSs in the Skopje region are described.

TS	Served Municipalities
„Shuto Orizari"TS – Shuto Orizari	Butel, Gjorche Petrov, Karposh, Saraj, Chucer Sanedevo and Shuto Orizari
„Vardarishte"TS – Gazi Baba	Gazi Baba, Arachinovo, Petrovets and Ilinden
"Morani" TS – Studenichani	Zelenikovo and Studenichani

- Option analysis on Transfer Stations. This paragraph describes different alternative solutionsregarding transfer stations, presenting the capacity of all potential TS:
- Business as usual (Variant 0) – no TSs: Each municipality uses its own existing means i.e.waste collection vehicles, open trucks, etc. to transport the waste to the CWMF
- Do-something (Variant 1) – two (2) TSs: at Shuto Orizari and Vardarishte.
- The paragraph describes the alternatives for uploading system and transportation equipment andthe results of the Break Even Points calculations.

- Then, the investment, operational and LevelizedUnit Cost were calculated for each option.Finally, taking into consideration the objectives of the chapter and the needs of the present projectsuch as travel distances and times the waste quantities, the optimal option is to have two (2) TS (inShuto Orizari and Gazi Baba „Vardarishte“).



1.7 PROPOSED INVESTMENT PROJECT

The main objective of chapter 7 (Proposed Investment Project) is the description of future waste management system from operational and technological point of view and the provision of detail CAPEX, OPEX and re-investment cost analysis. Also this chapter includes a description of human resources and promoter organization.

The conceptual design of the waste management system includes the description of the following:

- Waste storage, collection, transportation and transfer: Current equipment regarding bins andtransfer vehicles were presented per municipality. Then, taking into consideration the project teamassumptions, the calculations for the extra number of bins and vehicles required per municipalityare presented for the three waste streams: mixed municipal, recyclables and green waste.
- The TS sites and their characteristics: Analytical description of the transfer station infrastructure and equipment is provided, along with description of TS operating routines and staffing. The general layout of the selected TS is also provided.
- Analysis of existing dumpsites and non compliant landfills. This paragraph includes relevant information from the landfills and dumpsites survey that took place for the region, in order to perform risk screening procedure and define optimal remediation and closure approach. More specifically, it includes description of the identified sites, their risk classification and closure andremediation approaches for each of the identified sites.
- Regarding the human resources and promoter organization issue, an organizational diagram is provided. Also personnel requirements for the central administration have been described along with the hiring procedures. Organizational scheme for project preparation, organizational scheme for project implementation and organizational scheme for project operation have also been provided for the description of promoter organization.
- CAPEX, OPEX and reinvestments cost determination. In this paragraph, the total project cost is presented, along with the total investment cost for collection bins and investment and operational cost for waste transport.

Total investment cost for collection bins (€)	**2,600,893**
Total investment cost for collection trucks (€)	**2,905,770**
Total investment cost for TSs (€)	**2,853,854**

- Waste treatment and disposal. In this paragraph, the operating cost has been calculated for each waste treatment component: i.e. mechanical sorting plant, biological plant, landfill, infrastructureworks., along with the potential revenues from the operation of WMC.

1.8 ENVIRONMENTAL AND SOCIAL ASSESSMENT

The main objectives of chapter 8 (Environmental and Social Assessment) are the following:

- Sector Legislation (SEA, EIA) - Implementation of EIA Process. This paragraph describes the responsibilities of the Ministry of Environmental and Nature Protection as well as the Environmental Protection Act and the Environmental Permit Regulation that defy the EIA Study and environmental permit according to the beneficiary's country legislation.
- Baseline Assessment - Environmental and Social Impact Assessment. This paragraph includes data, points and conclusions for the selected site. Those data refer to:
    - Climate and Meteorological Data monitored at the nearest weather stations, related to temperature and precipitation.
    - Geological, Hydrogeological, Seismotectonic and Geotechnical characteristics of the site
    - Natural Features of the site, regarding land use features, nature and biodiversity, habitants and vegetation, local fauna.
    - There is also reference to areas of architectural, historical and cultural heritage and settlements in close proximity to the proposed project area.
- Potential environmental impacts, Mitigation Measures, Monitoring and Environmental Action
- Program. This paragraph presents the potential environmental impacts that could occur during the construction and during the operation and after closing of CWMF, especially water, air quality, soil, noise and traffic impacts. Additionally, potential impacts of the project on biological parameters, cultural property and population are identified. Finally there is a reference to the risk of accidents. Then, there are analyzed the mitigation measures that should be considered during the preparation procedure, the construction and the operation of the project, as well as during and after its closure. Finally, the proper monitoring processes are presented. Those refer to: water, air, noise parameters, waste and natural values.
- GHG Footprint Calculations. This paragraph aims to calculate the Green house gases emissions that can be included within the footprint generated from activities of the proposed waste management system. GHGs include the seven gases listed in Kyoto Protocol. Total emissions of these gases are counted in units of CO_2 equivalent.
- Climate Change adaptation/ resilience. This paragraph provides background information on climate changes and on the environmental policy in the context of mitigation climate change. Additionally, the paragraph summarizes projected changes in climate of the beneficiary country. Then, according to "The Non-paper Guidelines for Project Managers: Making vulnerable investments climate resilient forms part of the overall EU effort to mainstream climate change adaptation, following on from the White Paper on Adapting to Climate Change published by the Commission in 2009", the relevant Modules are followed in order to identify the proper Adaptation to Climate Change measures for the project.
    - Modules 1-3, Sensitivity analysis, evaluation of exposure, vulnerability analysis.
    - Module 4, Risk assessment
    - Module 5, Identification of adaption measures
    - Module 6, Appraisal of adaptation options

1.9 FINANCIAL AND ECONOMIC ANALYSIS

The main objectives of chapter 9 (Financial and Economic Analysis) are the following:

A. Financial Analysis

- Methodology of the Analysis. This paragraph presents the methodology of cost benefit analysis used, which is discounted cash flow (DCF) analysis.
- CAPEX overview. This paragraph describes the Total Investments schedule breakdown. The Total investment consists of two major parts. The eligible part of it and the non Eligible part. The eligible part will be subject of EU co financing with the present will derive from the Funding gap estimation.
- OPEX overview for with project scenario. This paragraph describes the Operation and Maintenancecosts which were grouped in the following nine cost centers:
- Mechanical Treatment of Mixed Municipal Waste and Mechanical Treatment of Recyclables
    - Biological treatment (Anaerobic Digestion & Biostabilization);
    - Landfill for residues (WWTP included);
    - Windrow Composting (for green waste);
    - Infrastructure Works;
    - Transfer stations;
    - Transportation costs direct to WMC and to Transfer Stations;
- OPEX overview for without project scenario. The main assumption for the "Without Project" scenario is that no investment will take place in order to change the capacity and the nature of the works that exist until now.
- Cost Implication to the Consumer, Affordability Analysis and Operating Revenue Forecast. This paragraph includes the calculations for the revenues with and without project scenario followed by the affordability analysis.
- Financial return on investment and performance indicators calculation. In this paragraph is estimated the crucial financial performance indicators which prove if the project needs financial contribution from EU Funds. These indicators are the Financial Net Present Value of the net cash flow of the investment, under financial discount of a rate 4% and the financial rate of Return.
- Funding gap calculation. The financial model developed for this project takes into account the EU grant calculation mechanism. The steps followed to determine the EU grant in accordance to the guidelines are presented in this paragraph.
- Financial return on national capital and performance indicators. This paragraph presents calculation of financial performance indicators under the proposed financing scheme.
- Financial sustainability reports. This paragraph presents Income statement and cash flow statements of the analysis period.

B. Economic Analysis

- Methodology. This paragraph refers to the objective of the economical analysis and the methodological steps for the economic evaluation of the project applied as proposed by the EU CBA Guide.
- Analysis of socioeconomic costs. This paragraph presents the calculations of conversion factors (CF), including the calculation of the contribution percentages calculation of each productive factor to the

construction and O&M costs.

- Analysis of socioeconomic benefits. This paragraph includes the Revenues of the System Operation, External Benefits as well as other non-quantifiable benefits of the project that were not considered in the analysis.
- Economic performance indicators. This paragraph presents the calculations of performance indicators and concludes that he investment for this project adds to the society welfare and is worthy to be financed from National and European funds.

C. Risk Assessment

- Methodology. This paragraph presents the recommended steps for assessing the project risks.
- Sensitivity analysis. This paragraph presents the variables tested and the critical ones are identified.
- Risk analysis. This paragraph presents the results of the risk analysis performed by the Monte Carlo simulation method, concluding that the project has very high possibility (almost certainty) to be constructed and operated with low risk in financial and economic terms, as are requested by EU cofunding regulations.
- Qualitative risk analysis. Through risk matrix conducted in this paragraph, possible risk prevention and mitigation measures have been identified. It concluded that the overall level of residual risk is deemed to be fully acceptable, it can be therefore concluded that, provided that the project is awarded with EU funds.

1.10 PROCUREMENT AND IMPLEMENTATION

The main objectives of chapter 10 (Procurementand Implementation) are the following:

- Procurement Strategy: This paragraph describes definitions of terms used in procurement activities, the EU and beneficiary country's Legislation on Public Procurement, the basic principle governing the award of contracts which is competitive tendering and finally, the different types of public procurement procedures regulated by EU and the relevant national legislation.
- Tendering Strategy: This paragraph describes the stages of the Tender Process, the thresholds that apply in the case of public procurements for the estimated value and the Criteria for Grouping of Tenders. Additionally, the available contractual arrangements are described. Finally, Work, Supply and Service Contracts are described.
- State Aid Issues. This paragraph defines the state aid and the regulations that apply. It describes the Altmark criteria and the provisions in tender documents that need to be fulfilled.
- Procurement Plan: This paragraph describes the recommended different contracts that should be implemented.
- Implementation Plan: This paragraph illustrates the estimated timetable for the execution of theproposed works and services.

2. BACKGROUND INFORMATION AND REVIEW OF THE EXISTING WASTE MANAGEMEMNT SYSTEM

2.1 Background information: study background and project context within national waste management strategy an objectives

Tasks and responsibilities on the waste management field are in practice split among several institutions in the Republic of Macedonia. Regarding waste management issues, the Ministry of Economy (MoE), Ministry of Finance (MoF) and Ministry of Environment and Physical Planning (MoEPP) are responsible for common preparation of several regulations related to packaging and packaging waste and other end-of-life products. Inspection of the fulfilled requirements related to the products on the market is the obligation of the State Market Inspectorate (within MoE). The Ministry of Finance plays an important role in decision making/taking and in implementation of available and effective financial/economic instruments and funds to encourage the development of waste management, in particular on approval of setting fees/charges/surcharges/earmarked taxes, management of earmarked funds, and on the cost recovery mechanisms for MSW investments and executed services. MoF is in charge of the allocation of annual budgets for all Ministries and local communities, and executes expenditure monitoring, provides co-financing for projects under international financial support (grants, loans, warranties, etc) and finally, it approves the appointment of new employees in the State institutions.

As a consequence of the decentralization process in the country, a lot of responsibilities were delegated to the municipalities. The municipalities are responsible for many important activities: organising the collection, transportation and disposal of municipal wastes; supervising transportation and disposal of industrial non–hazardous waste, deciding on the location of waste management facilities, issuing local regulations on waste management, financing and supervising dump/landfill closures and termination of waste management facilities. It is confusing that municipalities grant construction permits even if it is for their own investments and they even grant environmental permits (IPPC B-permits). The establishment of non-hazardous and inert waste landfills is also the responsibility of the municipalities. However, still a great deal of effort will be required to establish local administrative and expert institutions as well as operative organisations on the inter-municipal level, which shall be established and adopted by all involved municipalities.

In order to achieve successful co-ordination in the development process of the contemporary waste management system, monitoring and enforcement of waste management in Republic of Macedonia, all institutions should strengthen their capacities by additional re-organisation and financial resources, by additional employment and also by executing adequate training of staff at a national, regional and local level.Operative stakeholders in the waste management process execute the collection, treatment and landfill operations for all kinds of waste, regardless of their hazardous properties: public enterprises, waste handlers, and informal collectors of usable waste fractions. Some enterprises are in possession of their assets and operate their own waste treatment facilities and landfills.

However, in spite of the existing legal basis for gathering, recording and reporting on wastes that enter/leave the waste management process, environmental monitoring of waste management facilities is almost not carried out, a functioning data recording and reporting system is not fully operative yet.Other institutional stakeholders in waste management processes and development are associations like the Association of Local government units (ZELS), Chamber of Commerce, Association of Public communal enterprises, Association of Waste Handlers, NGO-s and scientific institutions of universities. Institutional stakeholders in waste management are particularly active in consultations regarding legislation, waste management functioning and financing, recognition and explanation of relationships between environmental parameters, development of environmental technologies and monitoring, and in the presentation of interests of different groups of society regarding waste management issues in the country.

Centersfordevelopmentoftheplanningregions(CDPR)

TheCentersfordevelopmentoftheplanningregions(CDPR)are8(eight)inR.Macedonia,formedinaccordancewiththelawofBalancedRegionalDevelopment.
Thepolicyofregionaldevelopmentisasystemofobjectives,instrumentsandmeasuresaimedtoreduceregionaldisparitiesandachievebalancedandsustainableregionaldevelopment.Thisisaccomplishedthrough:increasingcooperationamongplanningregionsbycapacitybuilding,optimizingandvalorisingnaturalwealth,humancapitalandeconomiccharacteristicsofthedifferentregions,conserving,developingandpromotingthespecialidentityofplanningregions,revitalizingthevillages,developingareaswiththespecificneeds,supportinginter-municipalandcross-bordercooperationoflocalself-governmentunitstopromotebalancedregionaldevelopmentandincreasethequalityoflifeforthecitizensintheregion.CDPRsperformthefollowingtasks:

- Preparetheproposedprogramfordevelopmentoftheplanningregion
- Preparetheproposedactionplanforimplementationoftheprogramfordevelopmentoftheplanningregion
- Prepareprojectproposalfordevelopmentoftheplanningregionandfortheareaswithspecial developmentneeds
- Coordinatetheactivitiesrelatedwithimplementationoftheprogramfordevelopmentoftheplanningregionandrealizetheprojectsfordevelopmentoftheplanningregion
- Provideinformationtoallstakeholdersfortherealizationofprogramfordevelopmentoftheplanningregionandotherissuesrelatedtoregionaldevelopment
- Provideprofessionalandtechnicalassistancetothelocalselfgovernmentunitsforpreparingdevelopmentprograms
- Provide professional services to the Associations for citizensand other stakeholders forpreparationofprojectsrelatedtoregionaldevelopment
- Promoteintermunicipalcooperationintheframeofplanningdevelopment
- Implementprojectforpromotingdevelopmentoftheplanningregion,financedbyEUfundsandotherinternationalsources
- Promotedevelopmentalpotentialsoftheplanningregion
- Provide professional, administrativeandtechnicaltasks forthe needsof theCouncil fordevelopmentoftheplanningregion.

TheCentersfordevelopmentoftheplanningregions(CDPR)inthefourprojectpilotregionsarespecificstakeholders,andalthoughtheyarenotdirectlyinvolvedinthewastemanagementsystem,intherealityhaveafocalrolefortheprojectontheregionallevel,reflectedalsointheirparticipationinthePSC.TheRDCareactivestructures,withgainedtrustamongthemunicipalitiesoftherespectiveregions,aswellasexperienceincoordinatingmunicipalitiesfordifferentactivitiesonregionallevel.TheCDPRwereinvolvedinthesettingoftheintermunicipalwastemanagementboards/enterprisesaswell,beingcoordinatorsandprovidinganactingprovisionalmanagerfortheregionalwastemanagementbodiesestablished.Inthispositionandsituationtheyexercisehighinfluencetoalllocalstakeholders.

TheCDPRareinvolvedintheprojectfromthebeginningofitsimplementationandhavedemonstratedaverystronginterestandsupport to the projectactivities.Itis expectedthatthisactiveness and supportwillcontinuethroughouttheprojectimplementationperiodandtheCDPRwillhaveacentralroleincoordinatingthemunicipalitiesfordifferentactivitiesonregionallevel,supportandstrengtheningoftheintermunicipalwastemanagementboards/enterprises.TheinterestoftheCDPRmaybedefinedtoagreatextentintermsoftheCentres’institutionalgoalsanddrivetowardsaccumulatingexperience,influenceandtrust.

IntermunicipalWasteManagementBoard(IWMB)

TheIntermunicipalWasteManagementBoardhasbeenrecentlyestablishedandisfullyoperational.TheIntermunicipalBoardshallbeseenasacomplementarybodytotheInter-municipalWasteManagementEnterprisecreatingacleardistinctionbetweenplanning/contractingandoperations,whichwillresultingreatertransparencyandpotentiallyhighercostefficiency.

Figure 2-1: The Main Functions of the IWMB

BasedontheassumptionthattheRWMBisandwillbeaplanningandcontractingunitandoperationwillbeconductedoncontractbetweentheBoardandeithertheIntermunicipalWasteManagementEnterprise,aprivatecontractororthemunicipality/PUE,thefunctionsoftheIWMBcanbedefinedasfollows:

- Management;
- Statutoryrequirements(permits);
- Finance(includingtariffs);
- Engineeringandprocurement(includingcontracting);
- PlanningandPR;
- Supervisionofoperators.

Public Utility Enterprises (PUEs)

The Municipalities hold the overall responsibility for waste management and the Public Utility Enterprises (PUE) are the main service provider of waste management services conducting the daily operation of waste collection services and landfill of waste. The Municipalities retain the responsibility for overall planning of waste management, tariff setting and the oversight of the PUEs.The State through the Ministry of Environment defines the national targets for recycling and landfilling in line with EU negotiations process, and stipulate them within national documents (Law on Waste Management and National Strategy on Waste Management), accordingly. The Ministry further organizes and assigns the competence for achieving goals at the regional level through the Regional Center and Intermunicipal Waste Management Board.

There are four principal ways for the delivery of waste management services in the future as listed below and illustrated in the following figure:

- Through the IWMB with the RWMC as the service provider;
- Through the IWMB with the private sector as the service provider;
- Through the IWMB with a municipality or a local PUE as the service provider;
- Through the municipality with the local PUE or the private sector as the service provider.

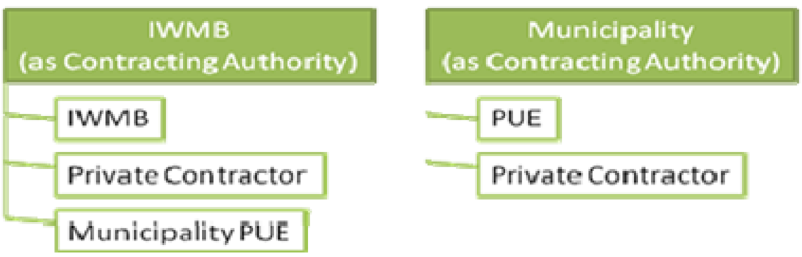


Figure2-2:ThePrincipalWaysforServiceDeliveryundertheFutureWasteManagementSystem

The IWMB must decide which services to be provided under the IWMB and how, and which services that will remain under municipal planning and implementation.

CURRENT SITUATION AND CHALLENGES

Collection

The City of Skopje is well served in its waste collection service and the PUE "Komunalna Higiena" (PEKH) collects and transports the household waste from nine of the Municipalities of the City of Skopje to the DLFC. The Municipalities of Aracinovo and Petrovets continue to dispose of their waste on illegal dumps.

There is no waste segregation, which limits the current potential for large scale recycling. Bring sites for the collection of plastic bottles are being rolled out across the capital. Scavenging is prevalent and it is believed that over 5,000 people are involved in unregulated scavenging of waste in Skopje. Scavenged material is then directly delivered to processors and scrap yards.

The majority of the wastes generated in the capital of Macedonia, Skopje and the region surrounding the capital are disposed of at the Drisla Landfill, which is operated by the Drisla Landfill Company ("DLFC").The IFC will assist the DLFC in the rehabilitation of and the improvement of the operations at the Drisla Landfill.

PUE "Komunalna Higiena" (PEKH) is a unit within the City of Skopje, Department of Municipal Affairs in the field of communal hygiene, maintenance and use of parks and greenery. It collects and transports the household waste from nine of the Municipalities of the City of Skopje as shown in Table 2-4.
There are also several private companies (PC), which collect and transport waste from semi-urban and rural Municipalities. The Municipalities Aracinovo and Petrovets dump their waste on illegal dumps.

Table2-1: Municipalcollectionarrangements

Urban municipalities	Rural municipalities	Mixed municipalities (semi- urban)
Centar PEKH	Saraj PC	Gazi BabaPEKH
Aerodrom PEKH	ShutoOrizari PEKH	Kisela Voda PEKH
KarposhPEKH	Arachinovo	GjorchePetrovPEKH
	ZelenikovoPC	ChairPEKH
	IlindenPC	Butel PEKH
	Petrovets	
	Sopishte PC	
	ChucherSandevoPC	
	Studenichani PC	

Objectives of the RWMP and indicators in accordance with the waste management hierarchy:
Collection of the municipal waste

- Providing collection and transport services to as many waste generators as possible-setting up systems covering the entire area of waste generators.
- Increasing the quantity of packagin waste collected. Implementation of separate collection system for recyclable materials to assure achievement of legal targets regarding packaging waste.

2.2 Project location description

Pursuant to the Decision adopted by the Parliament of the Republic of Macedonia on 29 September 2009, the Republic of Macedonia is officially divided into 8 (eight) regions, as follows: Vardar, Skopje, North-Eastern, Eastern, South-Eastern, Pelagonija, South-Western and Polog region.

The Skopje Region is located in the northernmost part of the country, it covers the basin of the Skopje Valley, spreading on a total area of 1,812 km^2 i.e. 7.3% of the total land area of the country and it is the smallest region. To the north, it borders Kosovo, to the south and south-west it borders Polog and Southwestern regions, to the south it borders the Vardar region and to the east and north-east it borders Eastern and Southeastern regions. According to Nomenclature of Territorial Units for Statistics - NTES, 2013 ("Official Gazette" No. 10 of 20.01.2014) Skopje Region is divided into seventeen (17) municipalities:

- Aerodrom,
- Arachinovo,
- Butel,
- Gazi Baba,
- Gjorche Petrov,
- Zelenikovo,
- Ilinden,
- Karposh,
- Kisela Voda,
- Petrovets,
- Saraj,
- Sopishte,
- Studenichani,
- Centar,
- Chair,
- Chucher-Sandevo,
- Shuto Orizari.

The municipalities Aerodrom, Butel, Gazi Baba, Gjorche Petrov, Karposh, Kisela Voda, Saraj, Centar, Chair and Shuto Orizari consist the City of Skopje.

The current population of the Skopje Statistical Region is 578,144 citizens according to the last population census in 2002. According to population estimates on 30.06.2015 from the State Statistical Office, the overall population of Skopje Region has increased approximately 7% (619,279 inhabitants). With 341.6 people/km^2 and 29.9% of the Country’s total population (2015), Skopje is the most populous region in the country.

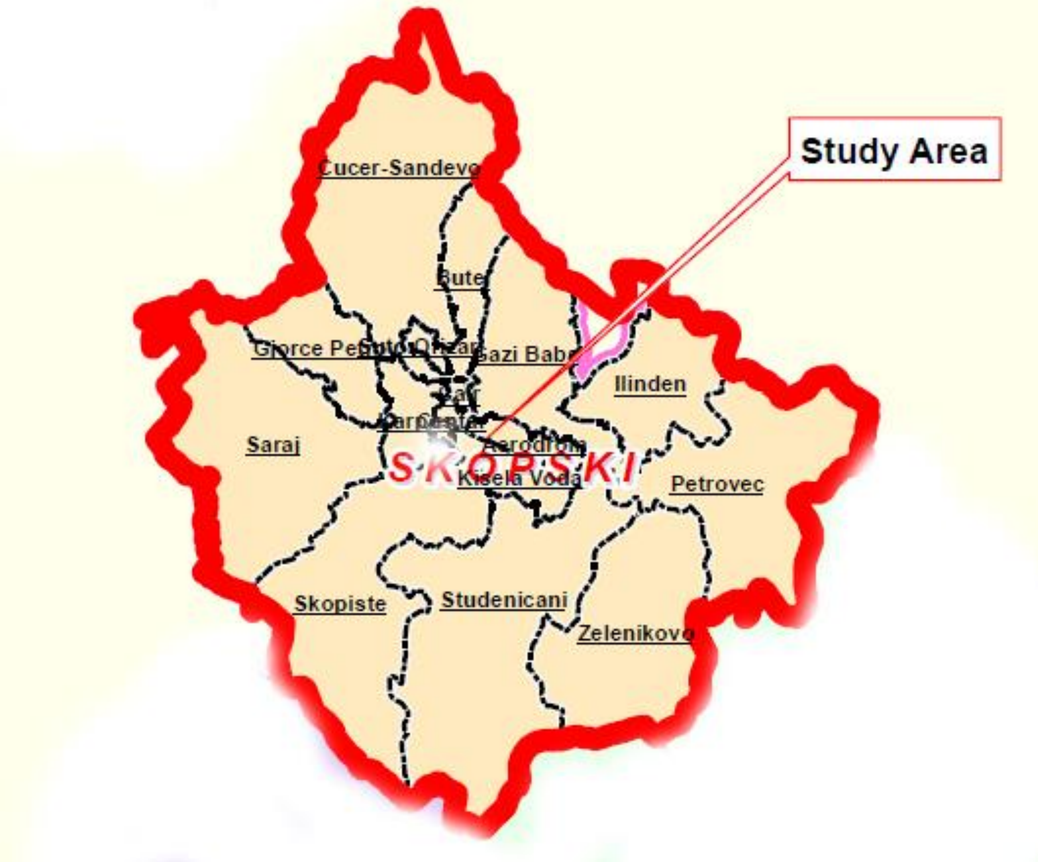


Figure 2-3:Study area of Skopje waste management Region

The terrain is characterized by alternately switching the high hills and deeply incised valleys and gullies with elevations on hills with very steep sides toward streams and gullies. Most of the route is represented by a flat - hilly terrain with occasional valleys and ravines. In Skopje region there are five (5) Natural Monuments, one (1) Protected Landscape, one (1) Strict Nature Reserve and five (5) areas with important characteristics that belong to the National Emerald Network of the Republic of Macedonia. In Skopje Region there are no protected areas with internationally recognized status.

This region is the main hub of the country and has the most developed traffic infrastructure. Most of the country’s industrial, trade and service capacities are concentrated in this region. The capital of the Republic of Macedonia is also located here – it is economic, administrative, academic and cultural center of the country. Hence, in terms of internal migration, this region is the largest immigration area. The region features 142 settlements. The population density is 341.6 people/ km^2 and it is four times higher than the country’s average (83.1 people/ km^2). 29.9% of the total population of the country (data from the year 2015) is concentrated in the region, which shows that the Skopje region has huge concentration of population. The Table below shows the municipalities covering the Skopje Planning Region along with their respective area and the total number of settlements.

2.3 Environmental and infrastructure aspects of the project

Geographical Location

Geographic information includes data about geographic location and other features of the region, such as natural or constructed features, land cover and land usage, including:

- land cover and land usage,
- topography,
- geology,
- hydrogeology,
- soils,
- climate,
- hydrology,

In addition, and due to project specific goals, data about road networks structure and current waste management practices (waste generated and collected and treatment or landfilling options) are also included in this chapter.

Topography

Wider region and the current area belong to two major geotectonic units Vardar Zone and Pelagonian horst anticlinorium. In the area of Mountains Mokra and Vodno, terrain runs by hilly - mountainous field, passes through flat terrain and mild, slightly hilly and hilly terrain.The terrain is characterized by alternately switching the high hills and deeply incised valleys and gullies with elevations on hills with very steep sides toward streams and gullies. Most of the route is represented by a flat - hilly terrain with occasional valleys and ravines.

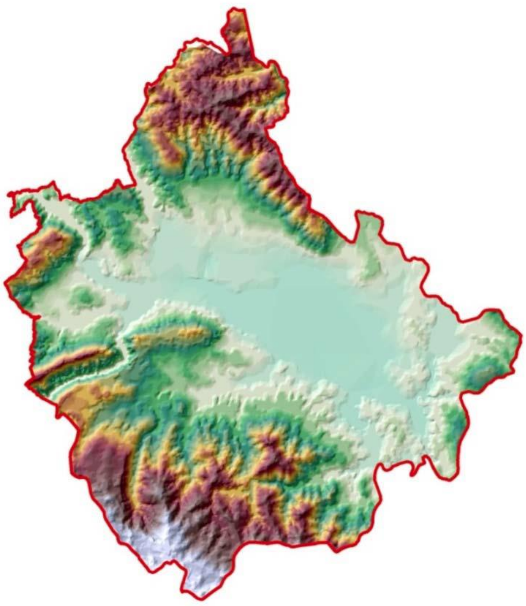


Figure 2-4: 3D Terrain Model of Skopje Region

Climate

As a continental country, the most important climatic factors in Macedonia are: geographical position, relief, proximity to the surrounding seas and atmospheric currents.

Republic of Macedonia lies in the temperate heat zone and is closer to the equator than to the North Pole. So it is get enough heat for the development of flora and fauna in the majority of the year. Due to its position, a four seasons are clearly expressed. Summer lasts from June 22 to September 23, and winter from 22 December to 21 March.

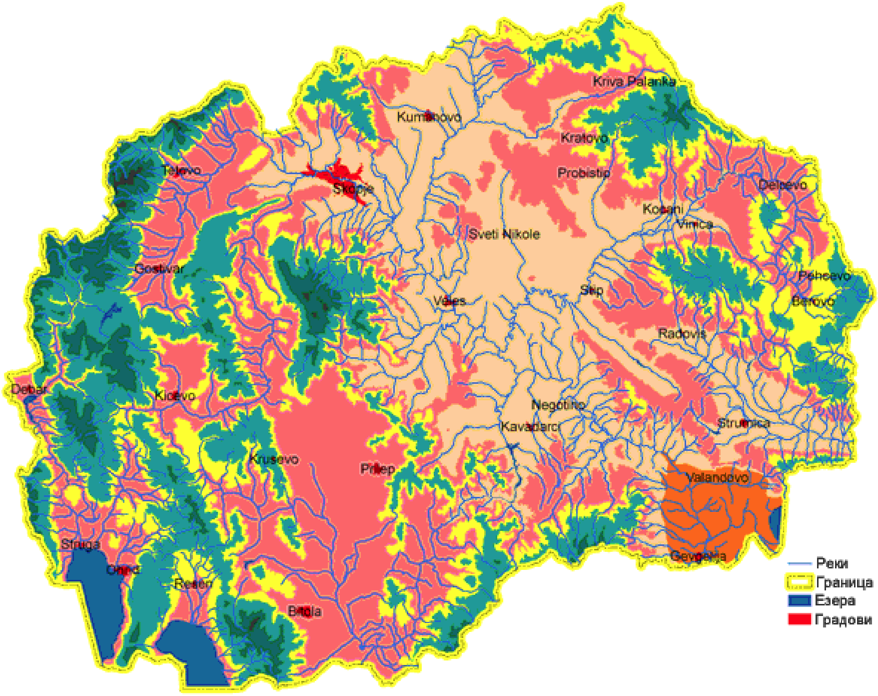


Figure 2-5: Macedonia climate map

The proximity of the Aegean Sea of just 60 km and the Adriatic Sea of 80 km have a profound effect on the climate in the Republic of Macedonia. This is especially evident in the valley of the river Vardar, Strumica, and less of CrnDrim where penetrating hot and humid air masses. Apart from the seas, the climate is affected from Atlantic Ocean from where come humid air masses especially in spring and autumn.

Relief with his height and direction of extension has a significant impact on the climate as well. High mountains in the western and southern part of the Republic of Macedonia prevent hot and humid marine influences to penetrate deeper inside. Their penetration is only possible through the valleys of the Vardar, Strumica and CrniDrim. On the other hand, medium high mountains and broad valleys in the north, allow infiltration of cold air masses from the north. Therefore, even in winter, in southern parts of the country temperatures can be much lower. Besides mountains, significantly influence have valleys.

Some valleys are surrounded by mountains on all sides, and in the winter their lowest parts can be very cold. Some valleys are filled with the lakes that do not allow the surrounding air to heat much in the summer or to cool much in winter.

Temperate continental climate with quite weak Mediterranean influences stretches along the valley of the Vardar, DemirKapija on south, to Skopje and Kumanovo in the north, then along Bregalnitsa to the east of Kocani and along the river Crna and Mariovo to the west. Here, winter ice is more common. The lowest temperatures go under -20°C, and in the summer climb to 45°C. High mountain areas are characterized by severe mountain climate, cold winters and summers, average annual temperatures around 0°C and rainfall around 1000-1200 mm, through the winter in the form of snow. The snow usually stays from November to May, and in the highest sides till August.

Geology

Skopje region belongs to two geotectonic units: Pelagonian horst - anticlinorium and Western - Macedonian zone which are characterized with their own specific lithological composition, tectonic structure and degree of metamorphism.

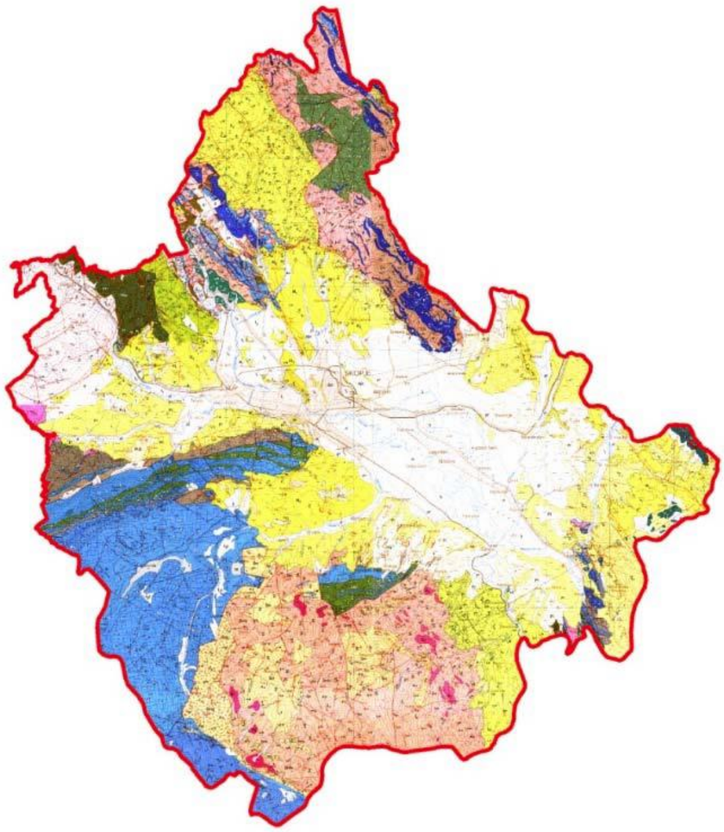


Figure 2-6: Skopje Region General geological map

General geological map analysis indicates presence of following rock formations:

PRECAMBRIAN

Two-mica amygdaloidal gneiss (Gmb): This variety of gneiss are is present in the central parts of the gneiss - micaschist series which is the most present. It has greyish color with additional tones such as greyish - creamy, greyish - pinkish etc. it is type of two - mica gneiss composed of quartz, potassium feldspar, plagioclases, muscovite and biotite as main minerals. As secondary minerals are present epidote, chlorite, garnet and titanite.

Bended muscovite gneiss (Gm): It is present in the north, or northwest edge of gneiss - micaschist series. It is medium grained with greyish - greenish color. The structure is lepidogranoblastic. In the mineral composition are present: quartz, potassium feldspars, plagioclases and muscovite, and as secondary appear biotite, garnet and titanite.

Micaschists (Sm): This unit represents micaschist mass in which appear garnet - graphitic and dystenmicaschists. Garnet - graphitic micaschists are black - grey with schistose texture and grano - lepidogranoblastic structure. They are composed of quartz, muscovite, garnet, graphite, and as secondary appear epidote, albite, chlorite, rutile, magnetite and titanite. Dystenmicaschists are characterized with coarse grey dysten crystals long several centimeters. They are composed of quartz, muscovite, dysten and garnet, and secondary are titanite, epidote and chlorite.

Garnet micaschists (Smg): They are grey - yellowish in color with folded texture and grano - leidoblastic structure. In mineral composition appear quartz, muscovite and garnet, rarely epidote and chlorite, and on certain places occur biotite, feldspar, rutile, amphibole, titanite, tourmaline and magnetite.

Cipollino marbles and marbles (Mm): Occurs in wide belts. Cipollino marbles are white, medium grained with dimension of calcite grains and muscovite leafs to 2 mm. Marbles are grey - white, medium grained with expressed schistose texture. They are composed of calcite grains with dimension of 2 - 3 mm, very rarely are seen small leafs of muscovite and quartz grains.

Albite gneisses (Gab): In larger masses are developed in the spring of the river Babuna. They are medium grained, grey - greenish with albite speckles large to 5 mm. in the contact parts with micaschists contain much mica and are very schistose, and further away of the contact are massive. Albite gneisses has porphyroblastic structure and in the mineral composition are present quartz, albite, microcline and greenish muscovite, and as secondary appear biotite, epidote, coisite, garnet, titanite, amphibole, chlorite, zircon and rarely calcite.

Marble series (M): This series is present along the valley of river Treska and mountains Karadzica, Suva and under the Neogene sediments in Skopje valley. According the lithological characteristics and the color are separated grey medium grained calcite marbles with thin seams of dolomite and dark grey to black medium grained calcite marbles.

Grey medium grained calcite marbles with thin seams of dolomite are placed concordantly above the mixed series and in their lowest part have character of plated cipollino marbles. Dark grey to black medium grained calcite marbles appear as stratified in thick beds, rarely plated. Mineralogicaly contain manly calcite and very little graphite matter.

White - grey medium grained dolomites (Md): Characteristic for this marble horizon is homogeneity. Mass of dolomite marbles starts with thin plated grey marbles which gradually move into stratified in thick beds and massive fissured grey - white and white marbles. In the mineral composition are present dolomite grains with secondary presence of calcite, quartz and small leafs of muscovite.

Medium grained grey - white calcite marbles (Mca): These rocks represent final horizon of marble series. With these marbles is composed canyon part of the river Treska from Kozjak to dam Matka. Their color is greyish white, medium to coarse grained with grain dimension of 1 - 5 mm. they are composed of calcite with occassionaly presence of muscovite leafs and quartz grains.

Granodiorite (γ): This igneous rock covers small area and can be seen only on spring parts of Kadina River and Markova River. It intrudes in gneisses for gneiss - micaschist series. The rock has massive to schistose texture and porphiroide structure. Composed are of quartz, potassium feldspar, plagioclases and biotite as main minerals, and secondary minerals are muscovite, epidote, chlorite, zircon, titanite and magnetite.

RIPHEAN CAMBRIAN

Graphite schists (Sgr): These are basic lithological member of the basal series. They are dark grey to black with folded schistose texture and grano-lepidoblastic structure. They are composed of quartz, graphite, muscovite, sericite, and as secondary appear on certain places occur biotite, albite, titanite and rutile.

Albitizedphylite - micaschists and green schists (Sab): Occur in thin bands. The rock is composed of fine leaf greenish mica with quartz grains among them, and grains of albite. Green schists are much present within the series and origin for pelite - psammite sediments, and during their sedimentation intruded diabase masses, so green rocks present on the terrain have para - origin.

PALEOZOIC

Graphitic sericite - quartz schists (Sgrse): These schists are developed along the northern slopes of Vodno, Osoj and Suva Gora as a thin band. Schists are composed of sericite - quartz mass with variable content of graphite matter. They have dark grey color, folded schistose texture anfgranolepidoblastic structure. In their composition are present sericite, quartz and graphite, and secondary minerals are albite and calcite.

Different albitized green schists (Sββ): This volcanic sedimentary complex is composed mainly of green schists in which composition are included different varieties according their mineral composition.

There are separated six basic types of schists: chlorite schists, epidote schists,glaucophaneschists, amphibole schists, sericite schists and clayey - sericite schists.

Carbonate schists and marbleized limestones (ScaPz2): This rock complex within the volcanic - sedimentary series occurs along the whole profile. With microscopic examinations is determined that prevail carbonate schists and marbleized limestones. Also, there is presence of phylite schists, slates, sericite - chlorite schists and rarely green schists.

MESOZOIC

Triassic sediments (T2?): These sediments are developed only in carbonate facies. According the lithological composition are separated dolomites and dolomite limestones, marbleized graphitic limestones and marbleized grey - white limestones. Dolomites represent the basal part of the series and appear as very thic belt on the southern slopes of Suva Gora. Lithological, dominant member in this horizon is dolomite, and dolomite limestones occur only in thin seams. Marbleized graphitic limestones are developed around the village Korito as a seam with variable thickness incorporated in the mass of marbleized grey - white limestones. The last ones represent the upper most parts of Triassic sedimentation. They are characterized with medium to coarse granular structure and grey - white color and mainly composed of calcite.

Cretaceous sediments (K23): Cretaceous sediments cover small area on the southeastern slopes of Vodno. They are presented with conglomerates in the basal part, above them appear fine to medium grained sandstones cemented with carbonate matter and the upper parts is composed of limestones with presence of sandy component. The thickness of the Cretaceous sediments is about 150 m.

CENOZOIC

Miocene (M3): Miocene sediments are developed in the basin of the river Markova and northern slopes of Vodno. According the lithological composition, Miocene sediments belong to basal and marl series. Basal series occupies the lowest parts of the Miocene sedimentary basin with presence of basal conglomerates, coarse grained sandstones, and above them is thick marl series which is characterized with presence of marls, clays, sandstones and sands which replaced each other.

Pliocene (Pl): Pliocene sediments have significant spreading within the Skopje valley where appear together with Miocene sediments. In the composition of Pliocene sediments are conglomerates, gravels, sands, sandstones, sandy clays and clays. Relationship with the older complexes is transgressive. In the lowest parts are developed conglomerate parts, locally sedimentation starts with clays. Above them is dark grey clayey facies followed with fine and medium grained sands, and final are gravels. Pliocene sediments are the most spread in the basin of Markova River and northern parts of Vodno.

QUATERNARY

Calcareous limestone (PlQ): Appears as small masses above the Pliocene sediments on many places in Skopje valley. Their thickness on some places is above 20 m. Gravels and sands (Q1): Appear in the areas composed of calcareous plates and are developed above them. Material is composed of different pieces, locally poorly bounded with carbonate - sandy cement.

Glacial - fluvial sediments (fgl): Occur in carbonate complex. They are composed of well sorted and processed rounded pieces of marbles, rarely gneisses mixed with sandy - clayey material. The thickness of this member is several tens of meters.

Slope carbonate breccia (dpr): It is present on steep slopes composed of carbonate complexes. This lithological member is composed of needle like small and coarser pieces of marbles bounded with marl cement.

Terra Rosa (ts): Appears in thin and thick layers within the karstified areas of Precambrian and Triassic carbonate complex. Terra Rosa filled the bottoms of bays and valleys.

Proluvium (pr): Proluvium has large spreading in the edge parts of Skopje valley. This material is poorly processed and composed is of coarse clastic pieces of different rocks mixed with clayey - sandy component.

Diluvium (d): Diluvial sediments are poorly developed and are connected with slight slopes of the mountain massifs. It is represented with clayey - sandy series followed with pieces of rocks which occur in the surrounding.

Upper river terrace (t2): Occurs along the river Treska. It is composed of coarse and well processed pieces of marbles, rare other rock masses, and sandy - clayey mass.

Lower river terrace (t1): It is formed along the rivers Treska and Vardar. It is composed of coarse grained gravels and sands with chaotic appearance vertically and horizontally.

Alluvium (a): Alluvium is the most spread Quaternary sediment and is present in Skopje valley and along the riverbeds of Treska and Markova River. Alluvial sediments that filled the riverbeds are represented with coarse clastic material composed of sand, gravel and clay pieces. Sediments in Skopje valley are thick about 100 m and material that composed them origin from different rocks that built mountain massifs.

Tectonics

Within Macedonia, above the basement tectonic units, there are two main groups of sedimentary basins that formed in late Eocene to Recent time and reflect two major periods of extensional deformation separated by a short period of shortening.

Most of the basins are related to extensional faulting and some are clearly ridges, but others are more complex and there is a wide range of basin types. The interconnected Tikves and Ovchepole basins in central Macedonia are an exception and contain both marine and non-marine strata that interfinger with volcanic rocks to the east. These strata lie in a for-arc position relative to a coeval volcanic arc to the east and a convergence zone to the west in central Albania where the Apulian plate moved east relative to Macedonia.

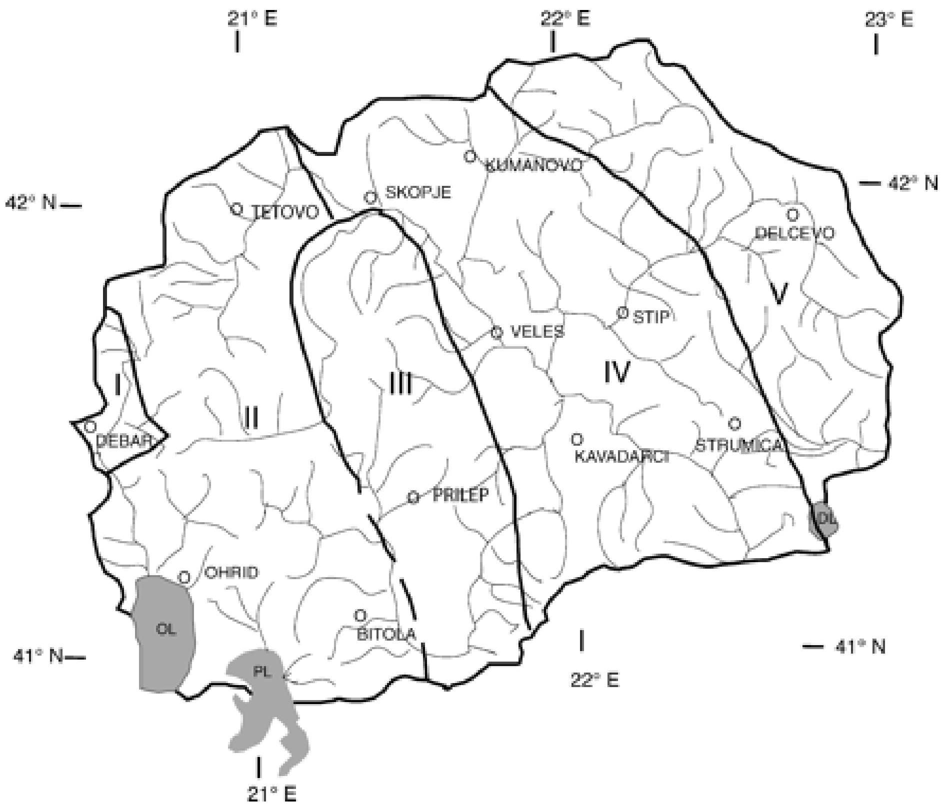
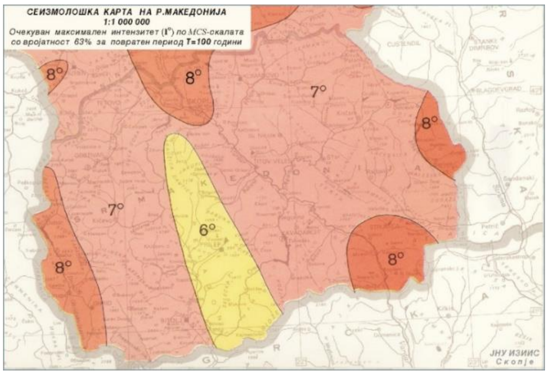


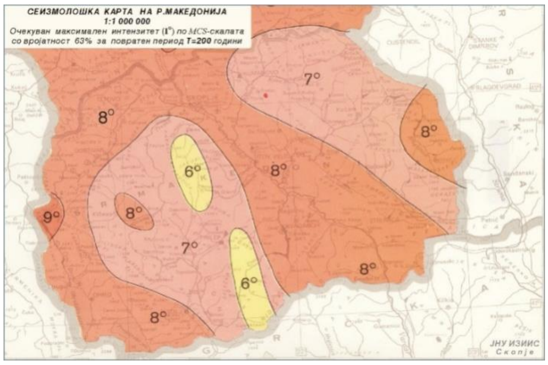
Figure 2-7: Tectonic map

Seismic Hazards

Area seismic activity is especially important for any construction structural stability and therefore it is a basis for any risk analysis procedure, as the strong earthquakes can have catastrophic consequences in very large areas. Part of the Skopje Region under consideration is not area marked with high seismic hazard, according to Macedonia seismic hazards maps (source: IZIIS, UKIM Skopje).



MACEDONIA SEISMIC MAP
Expected maximal intensity (MCS scale) with 63 % propability For return period T=100 years



MACEDONIA SEISMIC MAP
Expected maximal intensity (MCS scale) with 63 % propability For return period T=200 years

Figure 2-8: Macedonia seismic hazard maps for return period of 100 and 200 years (source: IZIIS – UKIM Skopje)

Soils

Land cover in Skopje region include lager number different soil types, mostly dominated by complexes of RendzicLeptosol, Chromic luvisol on saprolite, Regosol, Cambisol and Vertisol.

Cambisol are sandy - clay soils which are the most spread in the mountain regions on the height of 600 m above sea level. They are rich in humus - to 12 %, but humus matter is not very good quality. Reaction is weakly acidic - pH is 5.5 - 6. Usually, there is mountain vegetation and rare is used for agriculture. They are present in the lower part of the middle forest vegetation belt. The vegetation is formed entirely under the influence of woody vegetation. Most common are the oak, then beech, black and white pine and fir tree. Dark cambisol is characteristic for the northern and near expositions. They are characterized with large thickness of the profile, and good expressed humus - accumulative horizon. They have large reserves of nutrients and high-capacity of active moisture. It made them, in most cases, soils with high forest vegetation properties, where successfully grow crops of beech, firtree, white pine and others.

Light cambisols are characteristic for the south and near expositions. They are with thin profile, with decreased humus horizon and many skeletal elements. Mainly are covered with white pine. Pine and firtree have poor growth and low productivity.The average humus content in the A horizon is 7%. The solum is not calcareous. The pH in water is close to neutral (average 6.5). The cation exchange capacity is high (for the A horizon, on average, 39eqmmol/100g soil).

The sum of exchangeable bases (S) is high (33eqmmol/100g soil in the A horizon) and the base saturation percentage (V) is also high, at around 84%. The humus composition has the following characteristics: there is a low percentage of insoluble residue (32-33%) and a fairly high percentage of humic (29%) and especially fulvic acids (38%). The ratio of these acids is fairly narrow (0.77 in the A and 0.67 in (B).

They form on compact quartz rocks, as well as on a number of compact acid, neutral basic and ultrabasic silicate eruptive and metamorphic rocks and, over small areas, on carbonate-free silicate sediments.

Chromic lepticluvisol on hard limestones are found only in the limestone and dolomitic mountains, at an altitude of 600 – 1,600m. The average depth of the solum is 56cm. The texture has the following characteristics on average: 12% skeletal material; physical clay (clay + silt) prevails (60%). The textural differentiation is clear. The (B) horizon contains 1.37 times more clay than the A horizon.

As far as the climate is concerned, these soils can be found in four vertical climatic zones: coldcontinental, piedmont-continental-mountain, mountain-continental, and sub alpic. These soils are found under a number of associations in the oak, beech and subalpic regions. The texture of the soils is heterogeneous: sandy loams, loams, and clay loams prevail.The skeletal content is quite high (average 25%) in the A and (B) horizons. The clay content averages 9% in the A and 12% in (B) and textural differentiation is low. On average, the (B) horizon contains 1.28 times more clay than the A horizon; argilogenesis is low and there is 1.24 times more clay in the (B) horizon than in the C. The sand content (coarse + fine sand) accounts for 2/3 of all the particle-size fractions. Coarse aggregates dominate in these soils (46% of the aggregates are larger than 3mm).

The macro aggregates show high stability (82.5% in the A horizon and 77.7% in the (B) horizon. The soils are characterised by high porosity (54% in the A, 41% in the (B) horizon on average). They have moderate water retention capacity (37% in A, 33% in (B)). The aeration is very high (17%) in the A and 13% in the (B).

The chemical properties vary within broad limits, depending on the parent material, altitude, climatic-vegetation zones.

The organic horizon contains approximately 19% humus. The mineral soils are also rich in humus: 6.6% on average in the Ahorizon. The soils are noncalcareous, with pH averaging 5.6 in the A horizon and 5.5 in the (B). Acid and moderately acid soils thus dominate. The cation exchange capacity in the A horizon is an average of 25 and in the (B) horizon an average of 20eqmmol/100g soil. The sum of exchangeable bases (S) is low: 13.5 in the A horizon, 9.9eqmmol/100g soil in the (B) horizon (B, so that V is around 50%, but it varies depending on the subtypes The humus has a distinctly different composition in different horizons. The insoluble residue is the most dominant followed by the fulvic acids, while the humic acids come third (the ratio is 1:0.48:0.41); the ratio between the quantity of the humic acids and the fulvic acids is below 1 (in the A horizon 0.87 and in the (B) horizon 0.51).

Regosol occur in basins, mainly on undulating terrain, over paleogenic, neogenic and diluvial sediments. Depending on the substratum over which they are formed, these soils are very heterogeneous in mechanical composition. The Regosol formed over residuum from acid rocks contain on average: 27% coarse fragments, 3% clay, 13% silt and 17% clay + silt. Sandy soils prevail, covering 83% of the area.CalcaricRegosol over tertiary sediments contain on average: 8-9% coarse fragments, 17% clay, silt 28% and 45% clay + silt.

The physical properties of carbonate Regosol are: porosity 50%, water capacity 38%, air capacity 11%, wilting point 15% and available water 23%. The chemical properties also show heterogeneity. The Regosol formed over residuum from acid rocks are without carbonate and contain around 2% humus. pH in water is on average 6.2, cation exchange capacity is 11.5, S = 4.5eqmmol in 100g soil and V = 38.7%. Silicate carbonate Regosol over Tertiary sediments contains more than 2% humus and 16% CaCO3 on average. Their reaction in water is averages pH 7.7. Some of the Regosol are under xerophilic hilly pastures. The rest are used intensively for agricultural purposes.

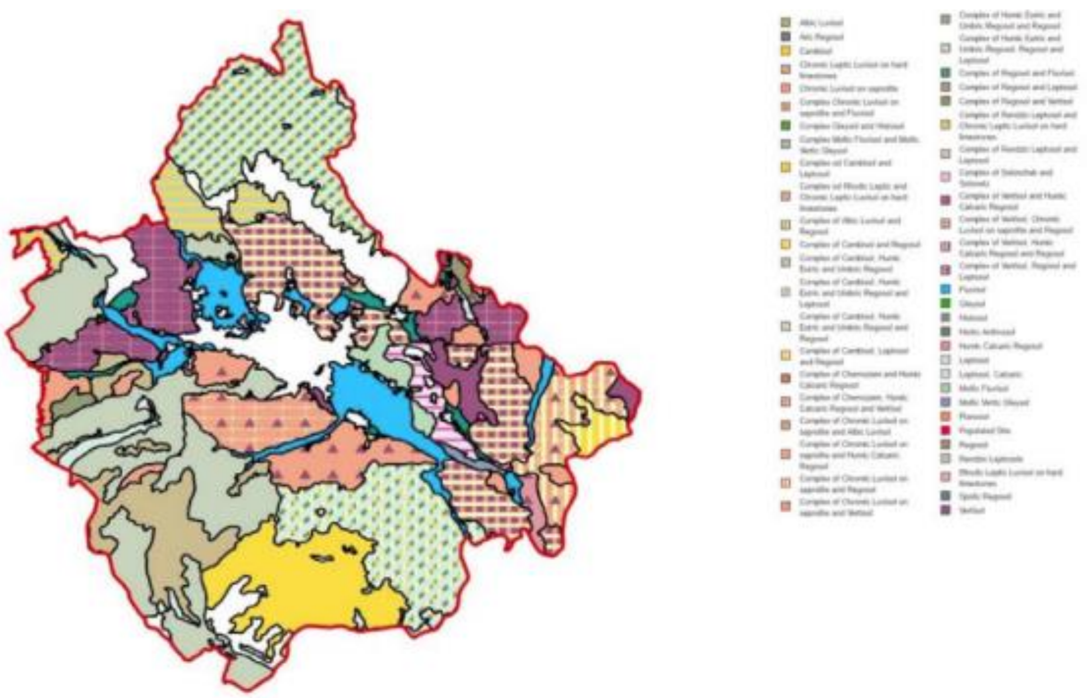


Figure 2-9: Skopje Region soil map (source: www.maksoil.ukim.mk)

Vertisol are identified as intrazonal, lithogenictopogenic soils. They are found together with other types of soil; depending on the parent material, with Regosol, rendzinas, chernozems and cinnamonic forest soils, and on basic compact rock with lithosols and vertic rankers. The texture of Vertisol is characterized by the following features: low coarse fraction (4% on average); the clay fraction dominates (clay + silt = 60%); clay is the dominant soil separate (40%) in the fine earth; there is little coarse sand in the Vertisol (9%), more silt (21%) and fine sand (30%); clay textures prevail and there is no texture differentiation.

There are very small areas of arenosol, formed on sand from the Vardar River that has been transmitted and deposited with the help of strong winds in the Vardar valley. Coarser macro aggregates dominate (above 3mm and especially above 5mm). The air capacity is low (2.7 to 6.5%, with an average of 4.2%). Aeration is low in wet conditions. Vertisol are characterised by high plasticity: the upper limit is 79%, the lower 38%, and the plasticity number is 41%.

The A horizon contains an average of 3.5% humus and an average of 5.3% $CaCO_3$ (calcareous Vertisol). The mean pH value for all Vertisol is 7.2. The exchange capacity is high and amounts on average to 38eqmmol/100g soil. Mean values of exchangeable alkaline cations are: Ca=56%, Mg=27%, H + Al=15%, K=1.0%, and Na=0.7%.

Exchangeable Mg cations dominate in the Vertisol on serpentinite and gabbro. These soils are characterised by a high percentage of humic acids, among which few are free. They contain little fulvic acids. The ratio between the humic and fulvic acids is high (1.75, and varies from 1.1 to 2.6). These soils contain a high percentage of insoluble organic remains.

Vertisol have large significance for agricultural production. They covered large areas in valleys. Fluvisols (alluvial soils) cover approximately twothirds of the flood plain surface and are among the best-known soils in these parts. They are characterized by their highly heterogeneous texture. The dominance of loamy soils (86%) indicates their favourable texture. The average texture is a follows: fine sand 51%, silt 30%, clay 10%, and coarse sand 9%. There are few coarse fragments (4%). In the surface horizon, these soils contain an average of 2% humus. Of the entire area of alluvial soils, non-carbonate soils make up 62%, and carbonate soils 38%. The average CEC of the soils is 19 in the top layer, while the S is 16eqmmol/100g of soil; consequently, the average V is 82%. Salt content is low (below 0.2%), with predominance of Ca and Mg bicarbonates. Alluvial soil can be found in the middle part of the valley that stretches to 100 m above sea level and are present downstream of Vardar. They are formed with deposition of fine material brought from rivers from the higher areas in the plains. They are water permeable, i.e. have a good capacity for the water permeability.

Colluvial (diluvial) soils are intensively used in the agriculture. They have very heterogeneous texture. On average, these soils contain: 10% coarse fragments, 10% clay, 20% silt and thus sand dominates (70%). The average value for porosity is 44%, for water capacity 34%, for air capacity 10%, for wilting point 11% and for available water 23%. They are also heterogeneous in their chemical properties. Lithosols contain on average 2% humus. The reaction of the surface soils in this group is as follows: neutral (44.7%), acid (42.7%), with a small number alkaline (12.6%). Dystric colluvial soils have a low cation exchange capacity (less clay, with more illite and kaolinite), which is on average 17eqmmol in 100g of soil, and the base saturation is 78%.

Diluvial soils are formed with erosion and transportation of mother rocks and soils from the higher (mountain and hilly) terrains with heavy water flow and surface water and the recent accumulation of eroded material in the bases of these fields.

Diluvial soil can become another kind of soil as a result of the impact of shallow groundwater or the influence of pedogenetic processes over the long term. They show great heterogeneity in horizontal and vertical direction. Diluvial soils compared with alluvial soils that are contiguous, are characterized by significantly lower productivity. They are poorly sorted, no flat terrain, poorly provided with water, have a worse chemical properties and contain fewer nutrients.

Agrogene soils are distributed in the agricultural area. It is those types of soils that are formed under the influence of man and serve for agricultural production.Aric regosols are soil that is formed by human intervention in grape seedlings (vinesols) and orchards.Hortizoles are anthropogenic soil type used in floriculture and gardening created from various soils.Rizosols are anthropogenic hipidromorphic soils. Rizosols are formed by colluvialand alluvial soils with prevalenceof alluvial soils. They are found in the river valleys i.e. in the flat-bottomed valleys.

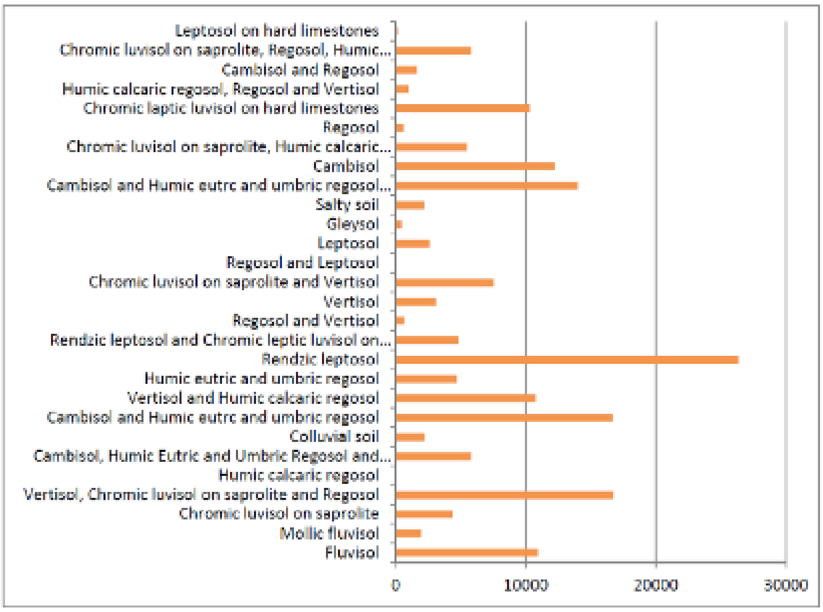


Figure 2-10: Soil types in the Skopje region (source: http://www.maksoil.ukim.mk/masis/)

Hydrogeological features

In Skopje region, from hydrogeological point of view, there are terrains with different water permeability. According the geological structure, there are types of wells with free level formed in the environment with inter-grain porosity, i.e. in Quaternary and Pliocene sediments. In the Eocene sediments, materials are hydrogeological complexes with individual layers with a collector and isolation hydrogeological function.In depth, these rock masses are more compact and have function of hydrogeological collector, and in depth are hydrogeological isolators. As relatively waterless areas, the investigated terrain includes tightly bound semi - petrified rock masses represented by Eocene sediments. Within the allocated types of wells, in terms of the groundwater regime (feeding, movement of groundwater, discharge and groundwater level), it can be concluded that, based on the geological structure of the field, a major factor for the formation of wells are persistent and occasional river flows and streams and atmospheric precipitation (rain, snow), which represent the main source of wells nourishment In the group of hydrogeological collectors are included proluvial - alluvial formations. Characteristic for them is typical super - capillary porosity. Proluvial sediments, depending of percentage of clay, could be relatively hydrogeological collectors.

In the group of hydrogeological insulators are classified gneisses (Gm) and micaschists (Smg), characterized by tight cracks and almost always are filled with dusty sandy clay.Eocene sediments, flysch series, represent hydrogeological complexes. Vertically changed hydrogeological isolators represented by marls and slates and relatively hydrogeological collectors - sandstones. Generally, they are waterless terrains.The main hydrological occurrence of this area is the river Vardar and its tributaries. In the dry year period, it is possible their waterways to reduce the flow of water, but not to dried.This shows that, along the flow of the river Vardar and its tributaries on the terrain, there are characteristic geological pre-conditions for formation of well zone. Namely, it is expected that the well zone is formed in very wide belt along the flow of the river Vardar. In that part, it is of boundary type, with free level, which is in hydraulic connection with the level of the water in the rivers.

According hydrogeological function, represented rock masses (soil materials) represent the most typical hydrogeological complexes and hydrogeological insulators and less to hydrogeological collectors. As hydrogeological collectors appear sandy - gravel sediments. Because of the large presence of hydrogeological complexes and hydrogeological insulators, along the trace, atmospheric precipitations practically, are not infiltrated in the ground, but part of them evaporate, and other part, through the dry ravines, is infiltrated in the river flows, and certain amounts of surface water with the influence of groundwater, formed wet zones, i.e. zones of occasionally flooding of the terrain, as modern geological phenomena and processes that need to undertake appropriate measures for drainage of groundwater.

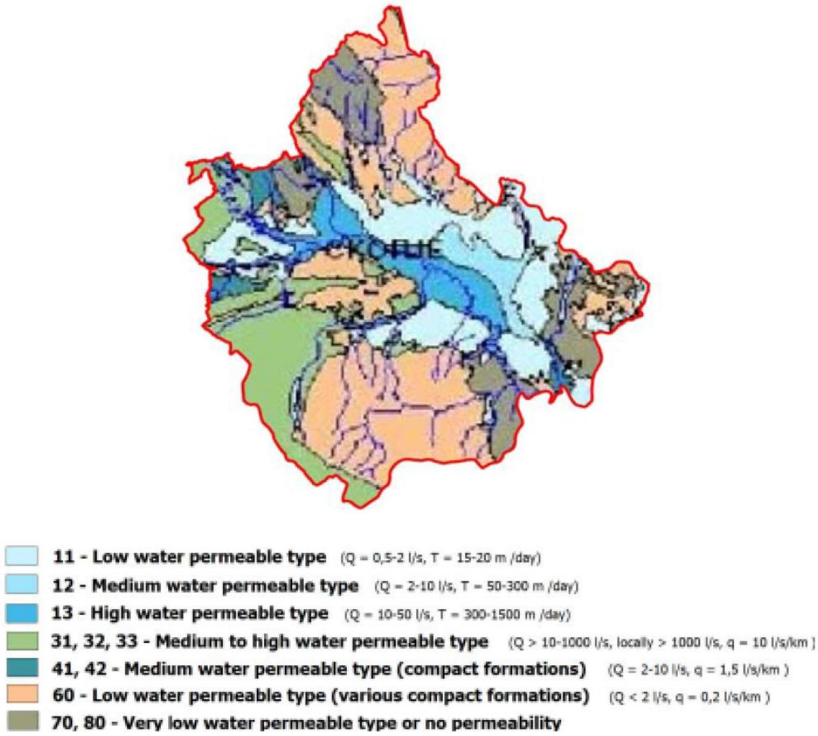


Figure 2-11: Hydrogeological characteristics and water permeability types (source: MOEPP)

According hydrogeological function, presentrock masses (soil materials) represent the most typical hydrogeological complexes composed mostly of hydrogeological insulators. Sandy - gravel sediments appear as only hydrogeological collectors. Because of the large presence of hydrogeological complexes (mostly hydrogeological insulators), along the trace, atmospheric precipitations practically, are not infiltrated in the ground. Part of them evaporates, and other part, through the dry ravines, is infiltrated in the river flows.

Certain amounts of surface water with the influence of groundwater, form wet zones, i.e. zones of occasional flooding, as modern geological phenomena that require appropriate drainage measure.

According the structure type of porosity of the rocks that appear in the catchment area of the Vardar river, four types of wells are separated:

- Boundary spring;
- Fissure type of wells;
- Karst type of wells;
- Terrains with low yield and waterless terrains.

Boundary springs–are type of wells formed in the rock masses with capillary porosity. Water masses of these wells is compressed, because the pores are directly next to each other and multiply connected. Boundary springs are formed in: diluvial, proluvial, alluvial and lake sediments and river teraces.

Fissure type of wells - are formed within masses with fissure porosity. Water is spread along the cracks as a set of "water veins", which are connected only where cracks crosses. Among the water veins there are waterproof rock masses, i.e. monolites. Fissure types of wells from the catchment area of the Vardarriver are formed in clastic, igneous and metamorphic rocks with Paleozoic and Mesozoic age.

Karst type of wells - are formed in carbonate rocks and layers. This specific type of wells occurs in terrains with karst porosity (channels and caverns). They can have free level and level under the pressure. Large dimensions of the karst pores, their connection and high level of water permeability make possible fast wells charging and discharge. Karst types of wells are feed directly with infiltration of atmospheric and surface waters along the channels and pores. Karst types of wells have large fluctuation of the groundwater level and large velocity, therefore they can be easily polluted and their natural purification is difficult.Waterless terrains – In the catchment area of the river Vardar are present Jurassic, Cretaceous and Eocene flysch. Flysch sediments (which, in term of hydrogeology, are waterproof) present waterless terrain, with rare occurrences of fissure springs which are characterized with small yield (0.10 l/s).

Hydrology

The hydrography network of the Skopje region belongs to Vardar basin. The river Vardar enters in Skopje region near the measurement station Radusa upstream of Skopje and exit near the measurement station Veles. The basin of Vardar river in Skopje region is 4 361 km^2.

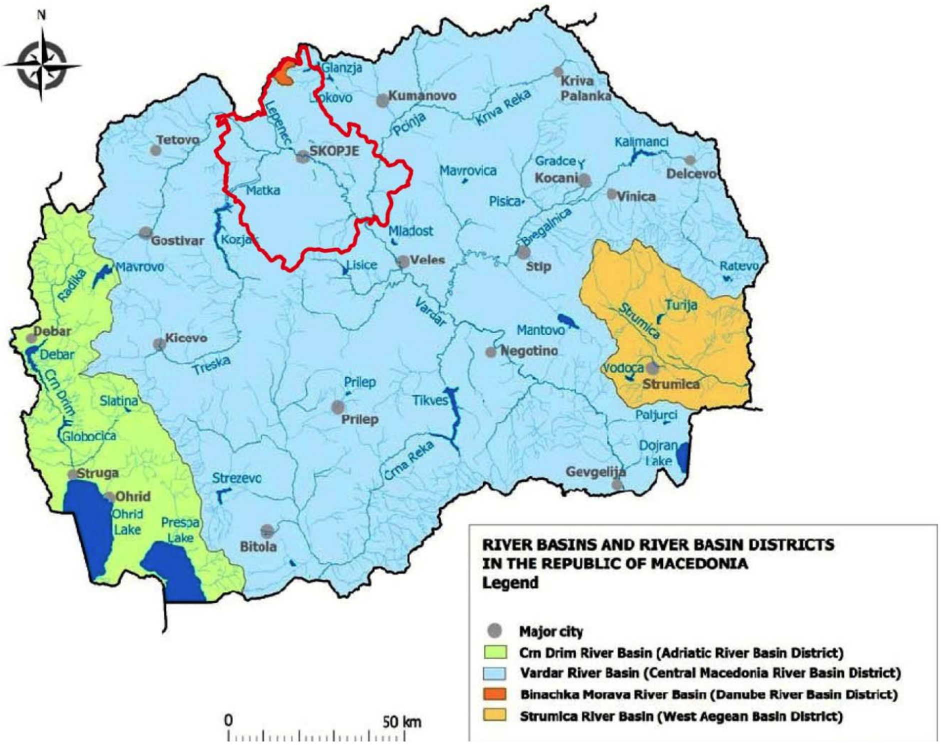


Figure 2-12: River basins in Macedonia

Larger tributaries of Vardar in Skopje region are:

- Lepenec
- Treska
- Pcinja
- Markova River
- Kadina River

On river Treska are built two acumulationsMatka and Kozjak, and in process of building is Sveta Petka. The biggest dam is Kozjak with volume of cca 600 milions m3 and height of about 100 m.

Beside hydro-energetic potential, rivers Treska and Kadina with their ambiental beauties offer excellent conditions for recreation and development of touristic - catering contents.

Some of the right tributaries of Vardar

Kadina River rises at high on the mountain Jakupica in locality JuruckaKarpa on 2100 m above sea level on east side of massif Mokra Mountain. It flows between the mountains Goleshnica and Kitka on Mokra Massif, among the surroundings of Skopje (southeast) and Veles (northwest).Catchment area of river Kadina is 182.4 km2, length is 33.5 km and average decline is 26.9 %.

Markova River rises in ridge of the massif Mokra Mountain, under the peak Pepeljak and flows toward north, getting water from its first tributary Patishka River. In the valley of the Markova River inflows three right tributaries Umovska, Cvetovska and Batinchica. Near Drachevo, the river Markova enters Skopje valley and flows along its alluvial plane in Skopsko Field, near the settlement Upper Lisiche, inflow in the river Vardar.

Catchment area of river Markova is 352 km2, length is 30.5 km and average decline 22.9 ‰. River Treska is a river in the western part of the Republic of Macedonia, a right tributary to Vardar. It rises in the Stogovo mountain at an altitude of around 2000 meters, and flows eastwards through the valley of Kicevo. At MakedonskiBrod it turns northwards, flows between the mountains of Suva Gora and Karadzica, finally flowing into the Vardar in the Skopje suburb Gjorce Petrov.

Three dams have been built on Treska:in 1937 the Matka dam and lake near Skopje, in 2004 the Kozjak dam and lake and in process of building is dam Sveta Petka.Catchment area of river Treska is 2068 km2, length is 113 km and average decline is 24.2 ‰.Basin of River Treska from the spring to the dam Kozjak is in the southwest region, the basin of river Pcinja to measurement station Katlanovska Banja is in the northeast region, and the river Lepenec inflows from Serbia and northwest region.

Basins of the rivers Markova, Kadina and other smaller rivers are in Skopje region.

Some of the left tributaries of Vardar

RiverPcinja origin in Serbia and when enters in Macedonia bends gently to the southwest. It passes next to the villages of Karlovce, Dragomance, Strnovac, Vojnik, Klechevce, Pčinja, Studena Bara, GornoKonjare, DolnoKonjare and the small town of Katlanovo, with the neighboring Katlanovska Banja, the most popular spa in Macedonia. The upper course in Macedonia creates a micro-region of Sredorek, and the lower a micro-region of Kotorci, with the gorge of Bader in between. In the lower course, the Pcinja follows the western side of the mountain Gradishtanska and flows into the Vardar river, on the gorge of Taor section of the Vardar's course, halfway between the cities of Skopje and Veles. Its catchment area is 2840.7 km2, length is 138.4km and average decline is 15.5 ‰.

Table2-2:Catchmentarea,length,averagedeclineandreforestationofrivers

River	Catchmentarea(km^2)	Length(km)	Average decline	Reforestation (%)
Treska River	2,068	113	24.2‰	75
Markova River	352	30.5	22.9‰	70
KadinaRiver	182.4	33.5	26.90%	80
LepenecRiver	770	76.7	19.80%	45
Pcinja River	2,840.7	138.4	15.5 ‰	50
Vardar River-Gevgelija	22,456	301.3	12.7‰	-

SignificantwatermeterprofilesoftheriverVardarareRadusha,SkopjeandVeles.

Table2-3:Averageflowsonthewatermeterprofiles

River	Profile	Basin (km^2)	Characteristicaverage flows (m^3/s)		
			Qsr	Qmax	Qmin
Vardar River	Radusha	1,461	26.7	276	2.60
Vardar River	Skopje	46,46	62.4	1,080	10.8
Vardar River	Veles	8,823	79.3	1,300	7.9

Legend:Qsr- averageannual flow; Qmin- absoluteminimal flow; Qmax- absolute maximal flow

Table2-4:Reviewofminimal,averagemonthlyandmaximalflowsofwaterfortheperiod1961-2005of *theriverTreskawithbasinof2060km²,hydrologicalstationLaki,282,45masl.*

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Qann(m^3/s)
Qmin	4.8	5.7	6.9	3.0	8.6	4.5	3.0	3.0	3.5	3.2	2.4	3.4	2.4
Qsr	24.0	27.7	37.5	46.5	41.4	22.0	11.9	8.2	8.7	9.9	16.7	22.6	23.1
Qmax	286	255	237	126	158	75	136	26	134	92	450	226	450

Table2-5:Reviewofminimal,averagemonthlyandmaximalflowsofwaterfortheperiod1961-2005oftheriverK adinawithbasinof182,4km²,hydrologicalstationSmesnica,212,21masl.

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Qann(m^3/s)
Qmin	0.33	0.39	0.80	1.24	0.31	0.28	0.11	0.10	0.08	0.08	0.17	0.26	0.08
Qsr	2.45	3.33	4.53	6.03	5.62	2.48	1.13	0.62	0.70	1.31	2.12	2.56	2.74
Qmax	23	22	32	68	35	33	15	24	23	45	118	20	118

Table2-6:Reviewofminimal,averagemonthlyandmaximalflowsofwaterfortheperiod1961 -2005oftheriverPcinjawithbasinof2195km²,hydrologicalstationKat.Banja,226.55masl.

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Qann(m^3/s)
Qmin	1.55	2.08	3	1.84	0.3	0.3	0.2	0.15	0.2	0.44	0.93	1.0076	0.150
Qsr	12.2	17.2	22.2	23.6	19.6	11.3	5.3	2.5	3.4	5.1	8.5	11.8	11.9
Qmax	168	181	206	224	202	124	100	44.6	65.8	147	180	168	224

Land Use

Land cover and land usage in the "Skopje" region are presented according to CORINE Land COVER for period 2006 – 2012period. According to CORINE methodology, geophysical cover of the Earth's surface is approached from two different angles:

- Land cover, which essentially concerns the nature of features (forests, crops, water bodies, bare rocks, etc.).
- Land usage, which is concerned with the socio-economic function (agriculture, habitat, environmental protection) of basic surfaces.

According to this nomenclature, Skopje region covers79 148 km2under forests.The category of agricultural areas,takes80 184km2 ofthe total area. Rest of the surface are covered with semi natural or artificial areas.According to CORINE Land COVER, major changes between 2006 and 2012 can be noted in artificial areas and forests and semi-natural areas, accompanied by decreased agricultural areas and water areas.

The statistical data on agricultural area in the Republic of Macedonia, by regions, show that in 2014 the least part of agricultural area was concentrated in the Skopje Region, covering only 6.3% of the total area.Land usage indicator shows the basic land structure, i.e. how much of the land is used as agricultural land and how large is the area under forest or used for other purpose. According to the CORINE methodology, agricultural land usage includescultivated land and pastures. Cultivated land is additionally classified as arable land and gardens, orchards, vineyards and meadows.Numerical data for agricultural land usage and production rates (crops, fruits, grapes) as much as data about forests by species, ownershipand usage are compiled from latest statistical reports available (www.stat.gov.mk) and include the year 2014 if not otherwise indicated. It must be noted that analysis of last three consecutive years (2012, 2013 and 2014) indicates stability, as no significant differences from year to year occurred.

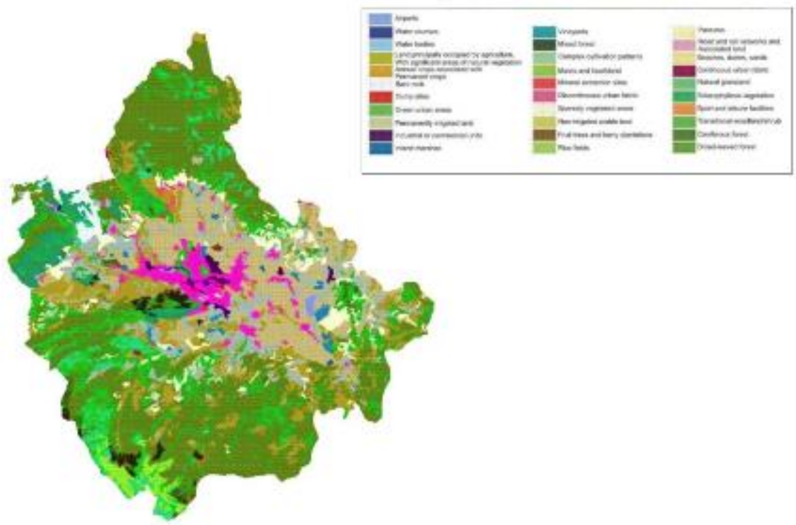


Figure 2-13: Land cover in Skopje region (CORINE)

Numerical data about Skopje region land usage are given in the tables bellow:

Table2-7:Landsurfacebycategoryofuseasper2014(source:www.stat.gov.mk)

Land usage in hectares (ha)	Republicof Macedonia	Skopje Region
Agricultural area	1,267,869	80,184
Cultivatedland– total	510,407	39,043
Arablelandandgardens	414,075	32,438
Orchards	14,622	788
Vineyards	21,269	2,043
Meadows	60,441	3,774
Pastures	756,558	41,108

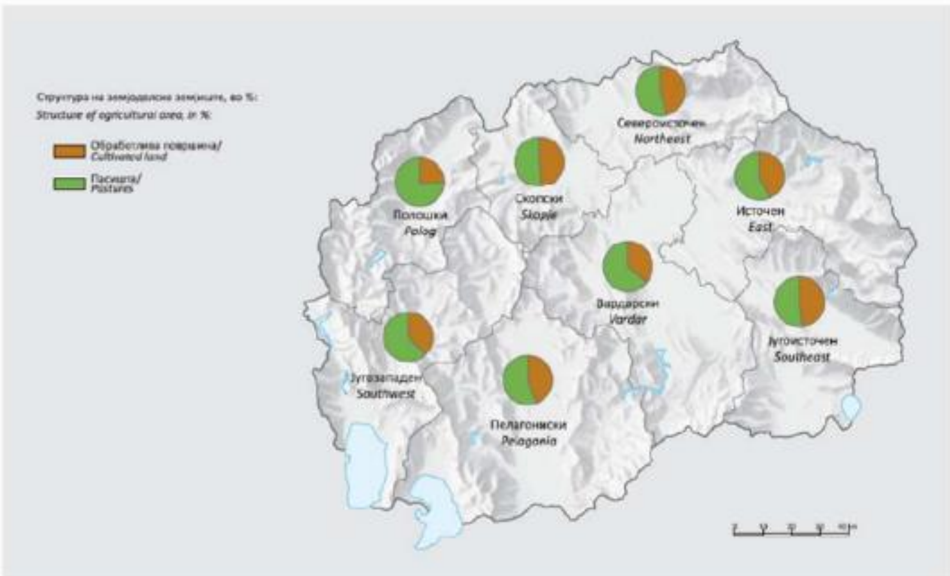


Figure 2-14: Structure of agricultural area in Skopje region as per 2014 (source: www.stat.gov.mk)

The Agricultural land includes areas used for the production: arable land and pastures. The data for the area of agricultural land in the period analysis of last three consecutive years (2012, 2013 and 2014) indicates stability, without significant differences from year to year. Pasture land is used for pasturing. They make up the majority of the Agricultural land and covered mountainous and lowland pastures. The total area under forests is 79 148ha.

Road Network

The length of the local road network in the Skopje region is 1363 km of the roads in Macedonia.

Table 2-8: Roads by type within Skopje region as per 2014 (source: www.stat.gov.mk)

Roads	Republicof Macedonia	Skopje Region
Highway	259	86
Local,km	9,513	1,363
Trunk, km	908	67
Regional,km	3,771	324
Railways, km	682	94,8

Figure 2-15: National roads map (source: Nations Online Project)

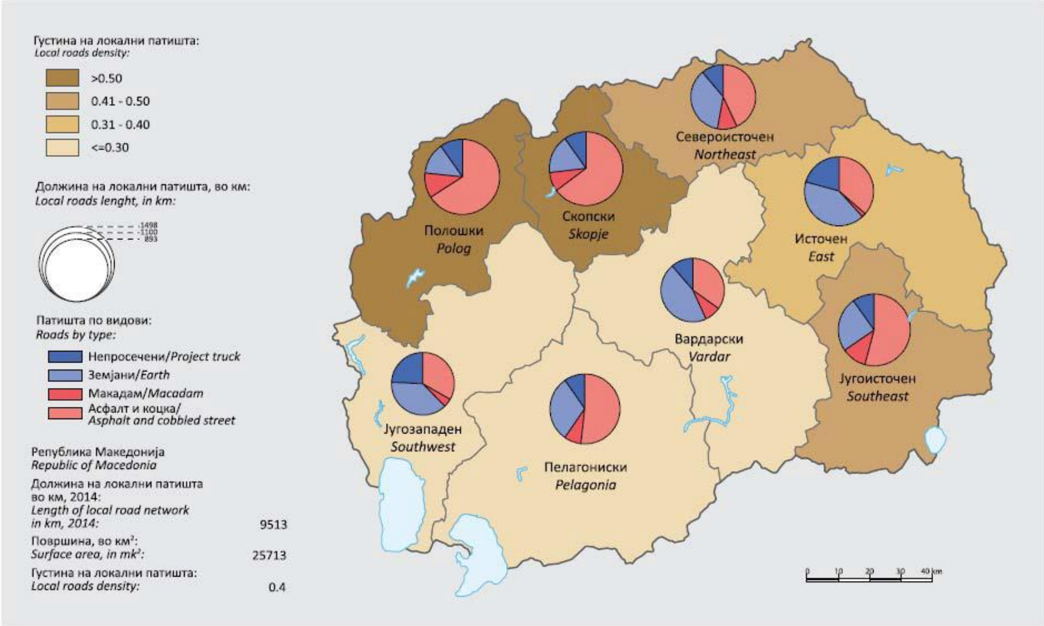


Figure 2-16: Local roads density as per 2014 (source: www.stat.gov.mk)

Protected Areas

Under the 2004 Law on Nature Protection, new categorization of designated area is introduced, aligned with the International Union for Conservation of Nature (IUCN), enabling inclusion of the national designated areas in the world network of designated areas. The Law stipulates a responsibility that, within 6 years, all designated areas (nominated before 2004) to be re-evaluated and designated accordance with the new categorization. Because of the current transitional period, the network of designated areas (areas designated according to the new categorization redesignated areas) the analysis (regarding the number and area they occupy) includes all designated areas in the Republic of Macedonia, designated under the old and also the new categorization. In doing so, the areas designated in accordance with the old categorization have been processed according to the appropriate/corresponding IUCN category. The analysis of the area of the designated areas has been made by rendering the borders of the areas in GIS (according to the data from the acts of designation or redesignation of areas, the Spatial Plan of the Republic of Macedonia, and where precise data in the Spatial Plan were missing, the area of the designated areas was rendered in accordance with the experts opinion).

In the analyzed period, the area of designated areas has grown, i.e. the share of designated areas in the overall area of Macedonia in 1990 was 7,14% and in 2015 it grew to 8,94%. Also, the number of designated areas recorded increase from 67 in 1990 to 86 areas in 2015, most of which – 67 areas – belong to natural monuments, followed by nature park with 12 areas. Thus, currently the designated area network comprises 86 areas, with total area of 229900haor8,94% of the territory of Macedonia. Most of it falls into the category national parks with around 4,47%, then natural monuments with 3,07% and the multipurpose area Jasen with 0,97% of the national territory.

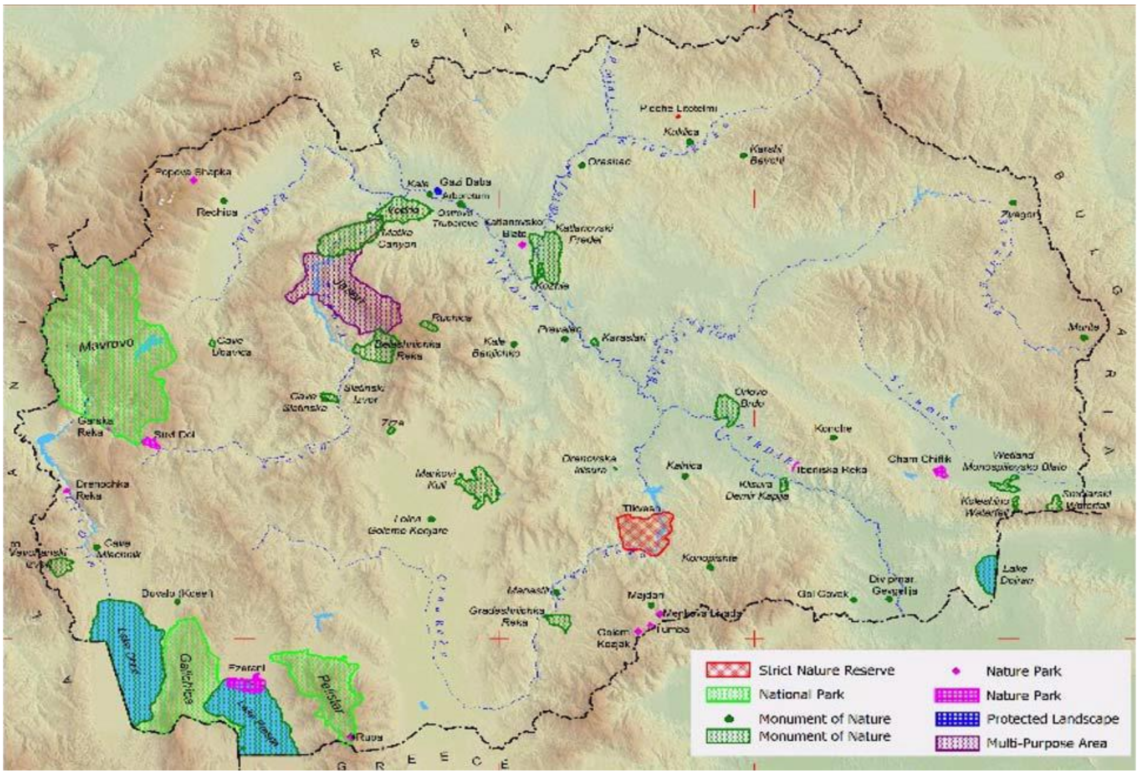


Figure 2-17: Protected areas in Republic of Macedonia under the categorization of IUCN

The establishment of the National Emerald Network consists of 4 phase process which was implemented in the Republic of Macedonia from 2002 to 2008 to identify the areas of special conservation interest (ASCI) and finally establish the Emerald Network. This network is established on the territory of the countries Parties to the Bern Convention and important part in the preparation of candidate countries for EU membership for the implementation of the EU Birds and/or Habitats Directives, or an additional tool in the process of establishing the coherent European Environmental Network Natura 2000.

The locations that have been identified in the National Emerald network are 35. Under the first project, implemented in 2002-2003, three areas have been identified: SNR Ezerani, NP Galicica and SR Dojran Lake, with a total area of 27660 ha (3,6%). In 2004 a second project was implemented, identifying another three areas: SNR Tikves, NP Pelister, SR Demir Kapija, with a total area of 28000 ha (3,8%). Under the third project implemented in 2005-2006, ten areas with a total area of 144783 ha (19,1%) were identified, while with the fourth project (implemented in 2008), another 19 areas were identified with a total area of 556447 ha (73,5%). The National Emerald Network of the Republic of Macedonia identifies 35 areas covering an area of 752223 ha or around 29% of its territory.

Figure 2-18: Emerald Network protected areas in Republic of Macedonia

2.4 Collection and treatment system overview

The waste management system in Skopje Region is based primarily on waste collection and disposal. The waste collection, transportation and disposal services in municipalities, are mainly provided by Public Utility Enterprises (PUEs). Currently, collection coverage in the region is variable and incomplete, especially in the rural areas, i.e., the most of the population that does not receive any collection service lives in rural areas. This has leads to the proliferation of illegal dumpsites located on the outskirts of settlements. The waste collection frequency varies among municipalities, mostly waste is collected once, to maximum twice a week from households.

Lack of collection equipment was considered a very serious problem for almost 71% of the municipalities, while old vehicle equipment was considered as a very serious problem for almost 57% of the municipalities in Skopje Region. The total capacity of bins in the region, is also not sufficient for the full collection of mixed municipal waste. In most cases, household waste is collected in 1,1m^3 containers and 120 l plastic bins, while waste generated from commercial/institutional buildings, is collected mainly in containers of 1,1m^3 and/or 5m^3.

As it can be seen from a Table 2-10 and Figure 2-19, the percentage of the population that receives regular service vary between municipalities, and ranges from 30% (Petrovets) to 100% (Ilinden & Sopishte).

Table 2-9: Amount of collected waste and collection coverage in Skopje Region

SkopjeRegion	Total collected waste 2016 (t)	Collection coverage (%)
CityofSkopje	139,802	95%
Arachinovo	2,028	60%
Chucher-Sandevo	1,457	80%
Ilinden	2,734	100%
Petrovets	672	30%
Sopishte	1,198	100%
Studenichani	1,800	50%
Zelenikovo	930	73%
TOTAL	**150,621**	**92%**

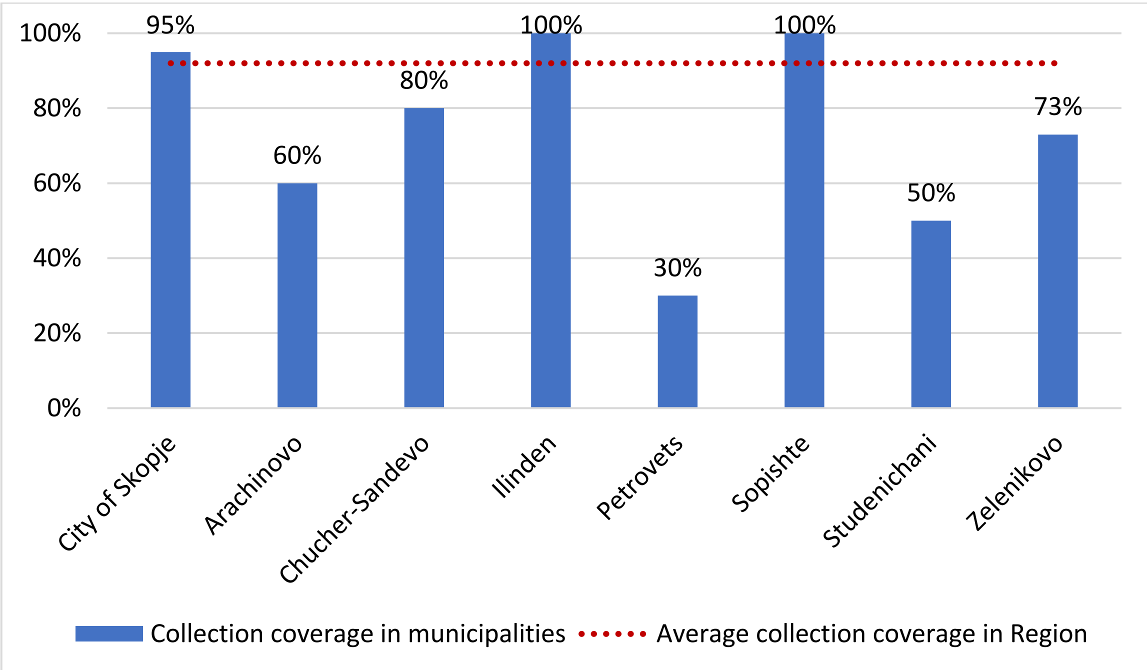


Figure 2-19: Collection coverage rates at municipality and regional level

According to a data obtained from waste quantity analysis performed during May 2016, amount of collected municipal waste in the Skopje Region was 150,621 t. Considering that annual municipal solid waste generation is 162,883 t, it can be concluded that collection coverage in Skopje Region is about 92%. From the total amount of collected municipal waste, about81% were collected from households, and the remaining 19% from commercial sector.

Currently, the municipalities hold the overall responsibility for the waste management, and the PUEs are the main service providers of waste management services conducting the daily operation of waste collection services and landfill of waste. The table below presents the PUEs per municipality in terms of collection and management of collected waste.

Table 2-10: Public Utility Enterprises (PUEs) in Skopje Region

	Administrative structureofwaste management			Landfill name/ Company operator ofthe landfill	Personnel for waste management service
	Nameof administrative structure	Scope	% of population covered		
Arachinovo			60%		46
Chucher-Sandevo	PUESCG"Mirkovci"-Skopje	Collection,Transportation	80%	Drisla/ DRISLA SKOPJE D.O.O.	
Ilinden	PUE"Ilinden"-Skopje	Collection,Transportation	100%		50
Petrovets	PUE"Petrovets" -Skopje		30%		
Sopishte	PUE"Sopishte" -Sopishte	Collection,Transportation	100%		
Studenichani	PUE"Studenichani"		50%		
Zelenikovo	PUE"Zelenikovo" -Skopje	Collection,Transportation	73%		4
CityofSkopje (9 municipalities: *Aerodrom, Butel,Karposh,KiselaVoda, Chair,Centar,Gazi Baba, Gjorche Petrov,Shuto Orizari)*	PUE"KomunalnaHigiena" -Skopje	Collection, Transportation	99%		1,168
Saraj (10th municipality of City of Skopje)	PUESaraj	Collection, Transportation	50%		

In the Municipality of Sopishte, PAKOMAK Company (Consortium) is responsible for collection and transportation of packaging waste in all 13 settlements of the municipality (100% population serviced).In the Municipality of Gjorche Petrov, "Eko-Flor" Company (private) is in charge for the collection and transpiration of waste. "Eko-Flor" is the responsible company for waste collection in rural area of the municipality, which is 10,607 inhabitants, or 25% of population, based on the agreement with the municipality.

In the Municipality of Shuto Orizari, DTT "SH Reviel" Skopje (Private) is in charge of the collection and transportation of waste. The company serves only one settlement, v. Gorno Orizari. The frequency of waste collection in households and commercial entities in that village is twice a weekend, and it covers 90% of the population (450 Inhabitants).

Out of the nine municipalities, five do not sort out recyclable waste and solely collect mixed municipal waste, these are Arachinovo, Chucher-Sandevo, Petrovets, Studenicani and Zelenikovo. Two municipalities have a separate collection for at least one recyclable waste stream Ilinden (paper) and Sopiste (plastics).Two other municipalities such as City of Skopje and Saraj have a separate collection of three recyclable waste streams (glass, paper and plastic).

The main MSW treatment option in Skopje region is landfilling. Except municipality of Arachinovo, which dispose waste on illegal dumps at its territory, all other municipalities dispose their municipal waste at regional landfill (Public Enterprise for Landfilling DRISLA). In 2012 the City of Skopje signed a concession agreement with a private company and established a Public Private Partnership – "AD DRISLA". In January 2013, an agreement was signed for joint investment in the Public enterprise landfill "Drisla Skopje" for performing concessionary activity, between the City of Skopje and the company FCL AMBIENTE.

Figure 2-20: Location of "Drisla" landfill

Waste disposal is provided by the local PUEs at the regional municipal landfill site. The site is operated on a controlled basis, but is not fully compliant with EU requirements.

The existing landfill does not have an engineered lining system or measures to control environmental pollutants such as leachate and landfill gas. There is no phasing of the landfill, which results in large expanses of waste left uncovered, leading to the inherent problems of vermin, scavenging, odour, litter, excessive leachate production and uncontrolled gas escape. The landfill currently has no leachate collection system in place and precipitation readily enters the waste and leachate emerges, escaping at a series of levels and flows out of the waste and downhill into the stream at the base of the site which subsequently joins the Markova Reka (river). Also, there is no gas extraction system in the current landfill and therefore gas is allowed to vent directly to the atmosphere. Construction and demolition wastes are not disposed of to the landfill, but are instead delivered to unregulated and uncontrolled dump sites around the Skopje region.

At the "Drisla" landfill site, a medical waste incinerator is also located. This comprises a single line, fed as required from wastes stored (in bags) in open-topped skips. There is no flue gas emission abatement equipment, and temperatures achieved during combustion are not in compliance with the EU Waste Incineration Directive. Currently hazardous medical waste collections, from the Skopje region, are approaching 500 tons per year.Furthermore, according to the field investigations, there are uncontrolled dumpsites, especially in rural areas not covered by the waste collection system. Small uncontrolled landfills, or so called "dumpsites" constructed without any engineering or other control measures for environmental protection were identified in 15 of the municipalities. In total, 57 dumpsites were identified within Skopje Region territory, from which 10% were evaluated as a high risk, 85% as medium risk and 5% as a low risk sites.

2.5 Current waste streams overview, waste generation and management

2.5.1 Municipal solid waste

A waste quantity analysis was performed during May 2016. The collection of data about the total mass of generated waste was carried out by weighing the mass of fully laden garbage trucks which collect waste within the territory of a municipality. The mass of fully laden trucks was weighed using a weighbridge of a utility company or other business entities in the territory of the local self-government unit, where the procedure is performed. Public utility companies provided all necessary conditions for implementation of quantitative analysis (weighbridge, supervision over the weighing procedure, result recording, etc.).The municipal waste mass was weighed during a period of one week. The procedure included standard circumstances. In order to calculate the produced waste for each Municipality of Region the following steps have been followed:

- The waste which produced from seasonal population have been estimated taking into consideration the assumption that an average tourist in Europe generates approximately 1,2 kg of waste per bednight (CREM, 2000).
- Segregation of the quantity of collected waste which derived from permanent and from seasonal population has been done.
- The percentage of collection coverage regarding household waste and commercial waste for each

municipality has been estimated taking into consideration data from Questionnaires.

The waste quantity analysis resulted in the calculation of the annually generated municipal waste in the region, and in the waste generation rate with or without the contribution of the seasonal population. Obtained results are presented in following table.

Table 2-11: Municipal solid waste generation rates in Skopje Region

Skopje Region	Population (permanent and seasonal)	Total generated waste, 2016 (t)	Waste generation (kg/cap/year)	Waste generation (kg/cap/day)	Participation in regional waste production
City of Skopje	540693	146590	271	0,74	90,0%
Arachinovo	13420	3395	253	0,69	2,1%
Chucher-Sandevo	9858	1821	185	0,51	1,1%
Ilinden	16864	2734	162	0,44	1,7%
Petrovets	8987	2270	253	0,69	1,4%
Sopishte	6036	1198	198	0,54	0,7%
Studenichani	20950	3600	172	0,47	2,2%
Zelenikovo	4710	1274	270	0,74	0,8%
Total	**621518**	**162883**	**262**	**0,72**	**100,0%**

Based on the obtained results on the quantity of generated waste, annual production of municipal waste for whole region is almost 163,000 t. Within observed municipalities, it is evident that the municipality with the largest population has the largest quantities of generated waste, as it is expected. The highest generation rate of municipal waste, among the 8 municipalities has Skopje, with more than 146,000 t/year. As it can be seen from Figure 2-21, taking into consideration the seasonal population, City of Skopje covers 90% of the overall waste production in Skopje Region.

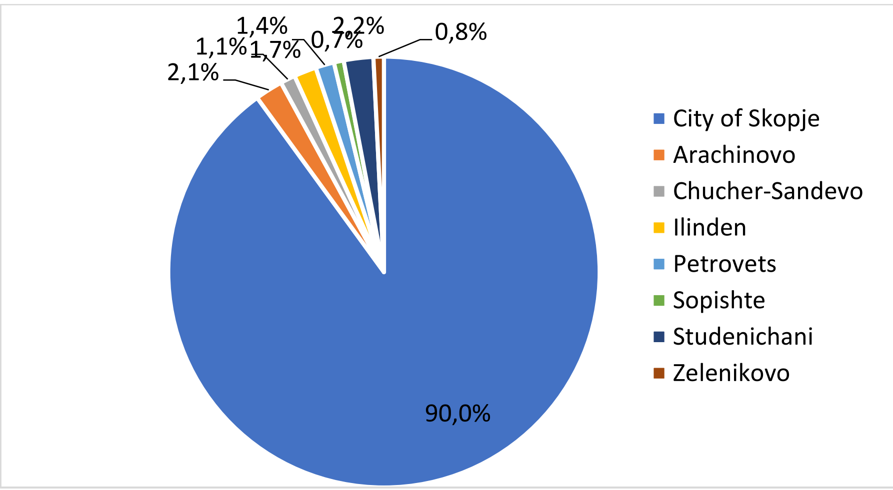


Figure 2-21: Contribution of waste production from each municipality compared to total waste amount in Region

Second highest waste generation is in Studenichani (3,600 t/year), followed by Arachinovo with close to 3,400 tons. The smallest amount of generated municipal solid waste have Sopishte (1,198 t/year), Zelenikovo (1,274 t/year) and Chucher-Sandevo with 1,821 t/year.

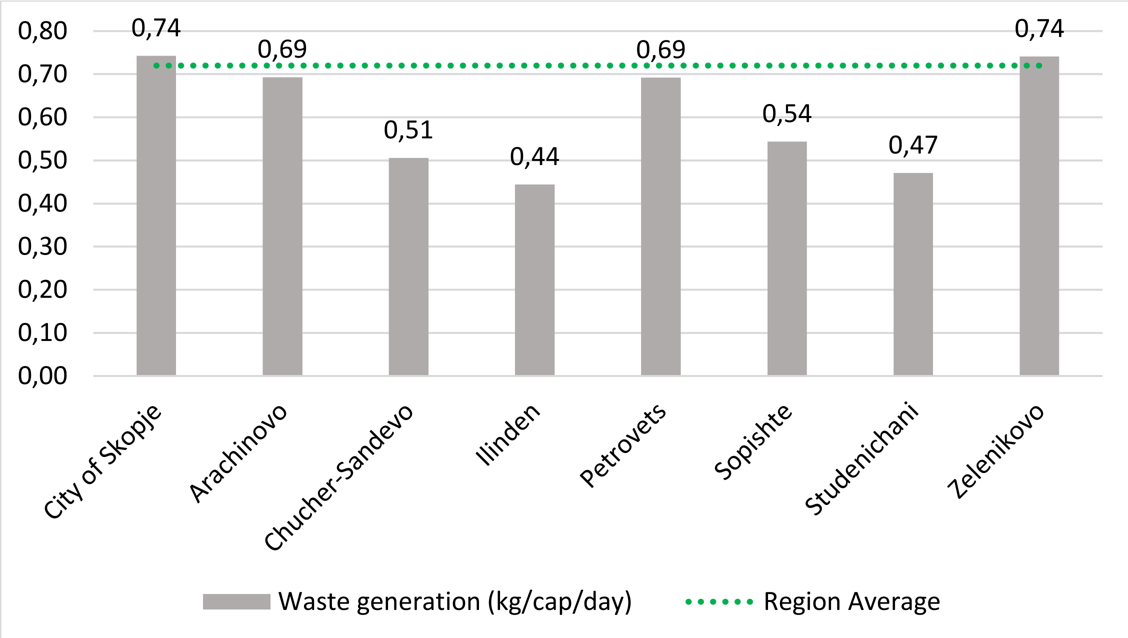


Figure 2-22: Comparison of municipal waste generation in observed municipalities (kg/cap/day)

For easier review and the possibility of comparison of the results on the generated quantity of municipal waste, the waste generation rate is usually expressed in form average per capita on annual or daily basis. Based on this, the weighted (average) waste generation rate for the whole Skopje region was calculated to 262 kg/ca/y. However, significant differences in terms of average waste production per capita can be observed depending on the specific municipality. The data presented in the Graph X.Y, indicate that the inhabitants of the municipalities of Skopje and Zelenikovo, have the highest rate of waste generation with 0,74 kg/cap/day. After the abovementioned municipality, the greatest amount of waste on a daily basis is generated by inhabitants of the municipality of Arachinovo and Petrovets (0.69 kg/cap/year). On the other hand, the lowest rates of waste generation have Chucher-Sandevo (0.51 kg), Studenichani (0.47 kg) and Ilinden with only 0.44 kg per capita per day.

2.5.2 Packaging Waste

According to the Law on packaging and packaging waste, the National targets described in the Article 35 for the treatment of packaging waste, include that within the territory of the Republic of Macedonia the following quantities of packaging and packaging waste should be collected and processed in the following timeframe:

- By the end of 2020, at least 60% by weight of packaging waste created in the Republic of Macedonia should be processed by operations or recovery operations with energy recovery.
- By the end of 2020, a minimum of 55% and a maximum of 80% by weight of packaging waste created in the Republic of Macedonia should be recycled.
- By the end of 2020, the following amounts of materials, that are produced packaging, should be recycled:
  - 60% glass,
  - 60% of paper and cardboard,
  - 50% metals,
  - 15% wood, and
  - additionally, by the end of 2018, 22.5% plastic, taking into account only such materials that are recycled into plastic.

In the Republic of Macedonia, for the year 2012, there were four legal entities which had permissions for treatment of packaging waste :

1. Pakomak
2. Euro - Ekopak
3. Ekosajkl
4. Eko - pak hit

According to the annual reports submitted to the Ministry of Environment and Physical Planning (3 Macedonian Environmental Information Center - MEIC (2016). Quality of the Environment – Annual Report *2015)* the total amount of packaging placed on the country's market in 2014 amounted to 59,572.8 t, while the total amount of collected packaging waste was 16,366.2 t.

Table 2-12: Packaging placed on the country's market (tons) in 2014, by material

Typeofmaterial	Placed on themarket in2014	Recycledmaterial	%ofRecycledmaterial
Glass	10,642.5	828.7	7.8
Plastic	17,375.3	6,100.7	35.1
Paper and cardboard	20,525.8	9,201.1	44.8
Metal	2,320.0	0.0	0.0
Wood	5,501.6	0.0	0.0
Composite materials	3,207.6	0.0	0.0
Other/ packaging not selected bytype	0.1	0.0	0.0
Total	**59,572.8**	**16,130.5**	**27.1**

In 2014, the total amount of recycled packaging waste, was 16,130.5 t, which corresponds to 27.1% of packaging placed on the market. Data about achieved recycling rates for different packaging materials, in mass and as a percentage of quantities placed on the market, are given in Table 2-13.

2.5.3 Medical Waste

Hospital care in Skopje Region is organized through a network of general, specialized hospitals, health centers and institutes. According to *“2 Annex of the Annual Report on DRG, 2011 “Usage of Hospital Capacities for cute patients”*, the number of hospitalized patients per year in the whole country is 3,239 patients, while the number of hospitalized patients per year in Skopje Region is 1,549 patients. The following table present the generated quantities (in tons) per type of medical waste according to the European Waste Catalogue (EWC), within Skopje Region.

Table2-13:Generatedmedicalwastereportedin2015inSkopjeRegion,accordingtoEWCcode

CodeofWaste	Description	Quantity
18 01	***Wastesfrom natal care, diagnosis,treatment orprevention ofdiseases in humans***	***336.9***
18 01 01	Sharps,butnotincludingthoseincludedin code 18-01-03*	30.5
18 01 02	Body partsand organsincluding blood bagsand bloodpreserves (excludingthose in category 18 01 03*)	1,1
18 01 03*	Wastes whosecollectionand disposal is subject tospecial requirements inorderto prevent infection	293.4
18 01 04	Wastes whosecollectionand disposal is notsubjecttospecial requirements inorder to preventinfection	6.4
18 01 06*	Chemicals consistingofdangerous substances	0.0
18 01 07	Chemicals notmentioned in 18-01-06	5.6
18 01 08*	Cytotoxic and cytostaticmedicines	0.0
18 01 09	Medicines other thanthosementioned in 18 01 08*	0.0
18 01 10*	Amalgam waste from dentalcare	0.0

2.5.4 Waste Batteries and accumulators

The Law on Management of Batteries and Accumulators and Waste Batteries and Accumulators (Official Gazette of the Republic of Macedonia No. 140/10, 47/11 and 148/11), prescribed requirements concerning environmental protection, which batteries and accumulators in their production and placing on the market of the Republic Macedonia, must meet. Also, treatment of waste batteries and accumulators, which covers, obligations and responsibilities of economic operators and other entities participating in the production and marketing of batteries and batteries, limiting the use of batteries and accumulators containing hazardous substances, the rules for the collection, processing, recycling and disposal of waste batteries and accumulators, as well as other conditions for handling waste batteries and accumulators, information and economic instruments to achieve national targets for the collection and processing of waste batteries and accumulators.

According to the submitted annual reports to the Ministry of Environment and Spatial Planning for 2014, the total amount of batteries and accumulators placed on the market in the Republic of Macedonia was 2,486,725.9 kg (portable is 51,087.5 kg, automotive batteries is 2,339,205.2 kg, industrial 96,433,2 kg). Automotive batteries and accumulators have the largest share in the total quantity of 94%.

In 2014 the quantity of collected portable batteries was 6,073.4 kg, automotive 2,599,819.5 kg and industrial 5,052.5 kg. The largest shares had collected waste automobile batteries and accumulators with 99.5%. The amount of treated and recycled waste batteries was portable 2,933 kg, automotive 2,494,736.98 kg and industrial 6,348.02 kg. Quantity of exported automotive waste batteries for treatment and recycling was 108,684 kg.

Table 2-14: Waste batteries and accumulators collected, recycled and treated or exported for treatment (kg) at country level (2014)

	Waste batteriesandaccumulators collected, kg	Waste batteriesandaccumulatorsRecycled, kg	Waste batteriesandaccumulators exported for treatment and
Portable	6,073.4	2,933.0	0.0
Automotive batteries	2,599,819.5	2,494,737.0	108,684.0
Industrial	5,052.5	6,348.0	0.0
Total	2,610,945.4	2,504,018.0	108,684.0

Pursuant to Article 35 of the Law on Management of Batteries and Accumulators and Waste Batteries set national targets for collection, including:

- by the end of 2016, you need to collect a minimum of 25% by weight of portable batteries and accumulators placed on the market in the territory of Republic of Macedonia
- by the end of 2020, we need to collect a minimum of 45% by weight of portable batteries and accumulators placed on the market in the territory of Republic of Macedonia.

2.5.5 Waste electrical and electronic equipment (WEEE)

The WEEE Law of the Republic of Macedonia takes effect from 2014. The law enforces take-back obligations on EEE producers and requires them to pay a high environmental fee from 2015 if they fail to meet collection targets through individual or collective waste plans. In September 2013 the first application to act as a compliance organization for WEEE, was submitted by “Nula Otpad” (Zero Waste)“.
According to a household survey conducted within the 2 year project “Balkan E-Waste Management Advocacy Network (BEWMAN), initiated by Metamorphosis Foundation (www.metamorphosis.org.mk) and co-financed by the European Union’s IPA 2008 Programme of the Civil Society Facility (http://www.eco-innocentre.mk/en/sections/electronics/documents/e-wasteassess), the highest

percentage, or 99% of the total population have refrigerator, 94% have washing machine, 92% have oven, 53% have some electric heating element, while only 20% have electric coffee machine.

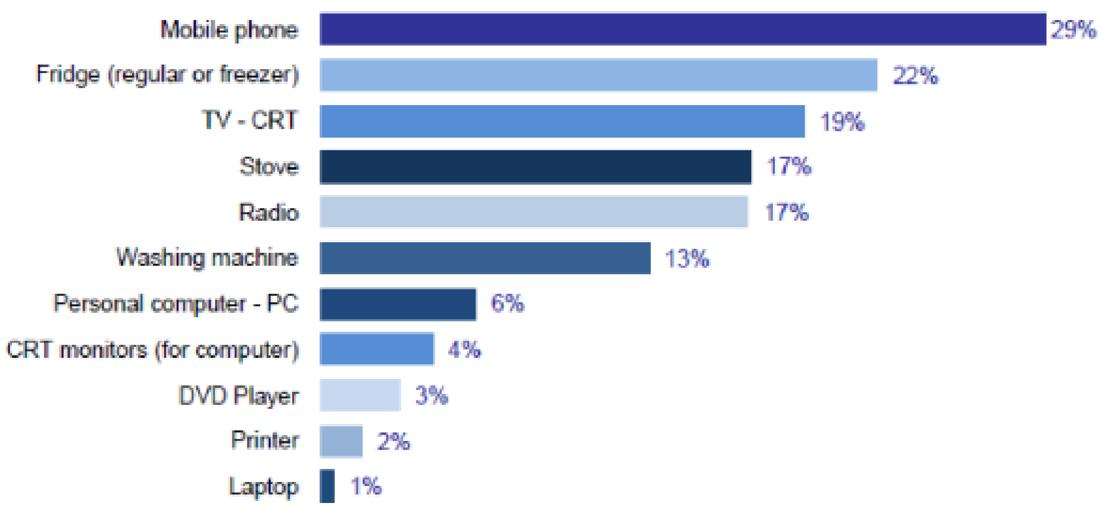


Figure2-23:Householdproductsthatarenotinuse,butstillkeptwithinthehousehold

About 40% of the total population that removed a refrigerator from home (which is 34%) gave the refrigerator as a donation/gift, while 30% gave it or sold it to a street dealer. The situation is similar with those 27% of the households that removed the washing machine from their home. 33% of them gave the mashing machine as a donation/gift, while 35% gave it/ sold it to a street dealer.

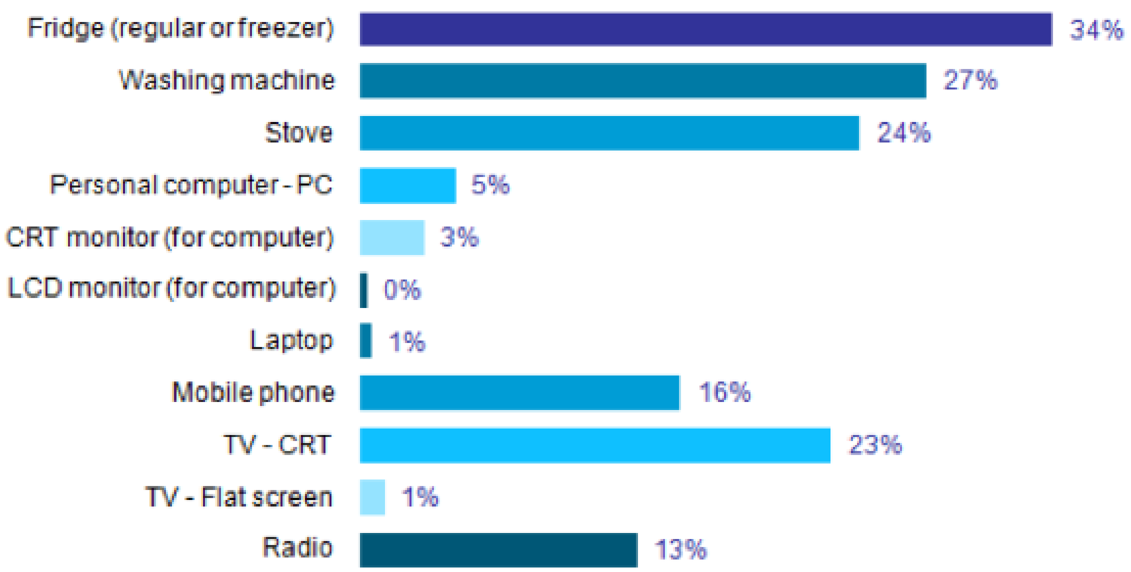


Figure2-24:Householdappliancesthathavebeendisposedfromthehousehold

2.5.6 Construction and demolition waste (C&D)

According to the National Waste Management Plan (2008-2014) of the Republic of Macedonia, there are no formal collection systems for Construction and Demolition waste, so there are no recorded data on quantities. The estimated quantities of Construction and Demolition waste, including excavated soil from contaminated sites (identified as number 17 according to EWC) for the Republic of Macedonia according to the Plan are based on experience in other countries and a generation of approximately 230-250 kg/capita/year is assumed; which corresponds to average annual generation of C&D waste is estimated at ranging from 460,000 t/yr to 500,000 t/yr for the year 2005.

Following the NWMP’s estimations, Skopje Region’s annual generation of C&D (including excavated soil from contaminated sites) waste is estimated at ranging from 142,434 t/y to 154,820 t/y (State Statistical Office’s estimation on population for 2015 was used).

2.5.7 Agricultural waste

In the following table, the amounts of different types of generated wastes for the year of 2012, that are related to the agriculture (horticulture, aquaculture, forestry, hunting and fishing) are presented, using the six-digit code classification of the European Waste Catalogue (EWC) and Hazardous Waste List, published by the EEA. The data refer to the country level.

Table 2-15: Amount of agricultural waste

Agriculturalwaste	Amountofgeneratedwaste(tons) in 2012
020101 sludges from washingand cleaning	4.2
020102 animal-tissue waste	53.46
020103 plant-tissue waste	1,451
020104 wasteplastics(exceptpackaging)	13.03
020106 animal faeces, urineandmanure (including spoiled straw),effluent,collectedseparatelyand treatedoff-site	46.66
020110 wastemetal	-
020199 wastesnot otherwise specified	0.5
020108 agrochemical wastecontaining dangerous substances	-
TOTAL	**1,568.9**

As can be seen from the table above, the total amount of generated agricultural waste in the Republic of Macedonia in the year 2012 was 1,568.9 t. The majority of generated waste, about 92% is assigned to the

020103 code, which is plant-tissue waste, while all other waste categories following with percentages ranging from 0.0% to 3.5%.

2.5.8 Industrial Waste

Skopje Region presents a considerable industrial activity which covers many different production sectors (Mining and Quarrying, Manufacturing and Electricity - Gas - steam and air conditioning supply).

According to the data provided by the State Statistical Agency for the Industrial sector (2014) and focusing on the non-hazardous industrial waste, in Skopje Region is produced 550,464.78 t of non hazardous industrial waste, almost the 30,5% of the overall country production. In more details the previous mentioned data are summarized in the following Table.

Table2-16:IndustrialWasteinSkopjeRegion(2014)

Skopje Region	Mining and quarrying hazardous waste (t)	Manufacturing hazardous waste (t)	Electricity,gas,steam and air conditioning supply hazardouswaste (t)	Total hazardous waste (t)
IndustrialHazardous Waste	488.65	11,950.90	49.95	12,489.50
Industrialnon-Hazar dousWaste	26,460.97	515,399.31	8,604.49	550,464.78
Total Industrial Waste	**26,949.62**	**527,350.22**	**8,654.44**	**562,954.28**

2.6 Recycling and recovery industry in usage

Formalized waste recycling is not particularly well established in Skopje Region, and there is no significant pre- sorting by the households.

The recovery and recycling activities for municipal waste are very limited and without any organized approach. There is no initiative on the municipal level to organize selection and recycling of municipal waste. It is mostly private companies that deal with recycling (scrap yards). Typically, recyclable materials are collected through a variety of methods including specific collections by individual private companies, collections from recycling yards and informal recovery (scavenging). There are no specific door to door collections of segregated recyclables.

The recovery of recyclable materials such as metals, paper, plastics, car batteries and accumulators, waste oils etc., is undertaken mainly by the informal sector. The recovery of many types/grades of potentially recyclable materials is not financially viable under the prevailing conditions. The logistical costs for a formal recycling system for paper are just covered by the sales price of paper. The informal sector, which has taken over the resources belonging to the closed down recycling network, is very active, though these resources are not used efficiently with both actual and potential economic and environmental consequences.

The following quantities of materials are collected from recycling yards for further recycling in Skopje:

Table 2-17: Quantity of materials recycled by scrap yards in 2004

Commodity	Collected/processed total in tonnes 2004	No. of companies
Paper and cardboard	7,125	9
Metal-ferrous	46,986	10
Copper	713	6
Aluminium	1,350	5
Hard plastic	199	7
PET	0,2	1
Film	92	4
Batteries	2,983	10
Glass	0	0
Tyres	170	3

Source: Annex V to the National Waste Management Plan and Feasibillity Studies, 2005

Paper recycling is undertaken by individual commercial and public entities. There are individual containers located around Skopje for the public to use and large containers at specific industrial outlets. Small quantities of PET bottles (39 t in 2010) and paper (15 t in 2010) were collected through specialized bins managed by PUE "Komunalna Higiena" which are spread around the City area. The main factory for paper and cardboard in Skopje is "Komuna Ad".

There is a well-established network of collectors and/or brokers for recovered scrap metals, as well as a strong and stable market. PET is not collected by the recycling yards, mostly because of the costly collecting system due to big volume of PET bottle and low weight.Informal recycling through scavenging is prevalent and the norm for the region.

2.7 Existing waste management system costs

The cost of services is determined on a monthly basis and includes all costs in accordance with the calculation made by the operator and it is based on: quantities of collected waste, number of individuals in the territory of the municipalities, number of entities classified according to the activity (amount and type of waste), dynamic collection, distance from installations. Type of container for waste disposal and type of utility specifically vehicle.

The individual and collective housing unit price for the service can be: MKD/m^2, MKD/m^3 and MKD/kg. With regard to legal persons there are the following three categories of users:

- Large legal entities (manufacturing facilities, shopping centers, factories, banks, hotels, insurance companies, warehouses and other legal entities) for which the unit cost of the service can be MKD/$m^2$and MKD/m^3.
- Small legal entities (supermarkets, grocery, offices, restaurants, etc.), categorized based on the type and quantity of waste unit price for the service can be MKD/$m^2$and lump sum.
- Schools, kindergartens, health care facilities, retirement homes, religious buildings, etc., for which the unit price of the service can be MKD/$m^2$and MKD/m^3.

Tariffs are presented separately for each household and business entity in accordance with existing services and the availability of facilities.

In Skopje region the tariff systems for households vary between the municipalities. In general, a system based on a flat rate per month or a system based on the property size is applied.In 9 of the municipalities of the City of Skopje (Aerodrom, Butel, Gazi Baba, Gjorche Petrov, Karposh, Kisela Voda, Centar, Chair and Shuto Orizari) the tariff is collected by PUE "Komunalna Higiena Skopje" and it is based on property size (urban households, commercial and private entities) and flat rate in rural areas. Especially in Saraj municipality, (10thmunicipality of City of Skopje), tariffs are collected by PUE Saraj and they are based on property size.Across the rest municipalities in Skopje region, tariffs range from 189 MKD in the municipality of Zelenikovo to 221 MKD in the municipality of Ilinden, per month per household. The tariffs for commerce and industry also vary between the municipalities, whereas the majority has systems based on the property size except the municipalities of Ilinden and Sopishte that have systems based on the quantity of waste generated by legal entities.

Table 2-18: Tariffs in the Municipalities of Skopje region

Municipality	ExistingtariffsystemforHouseholds(monthlyfee)		ExistingtariffsystemforcommercialandPrivateEntities (monthlyfee)
	Urban	Rural	
CityofSkopje	3.59 MKD/m²	286,00MKD/HH	5.50 MKD/m²
Saraj	2 MKD/m² (residential area) 0.5 MKD/m² (yard area)		250MKD(basedonpropertysize)
Arachinovo	200MKD/HH		
Chucher-Sandevo	Thepriceisdeterminedonaflatrate		12 MKD/m² for facilities up to 100 m² area & 3 MKD/m2 for facilities over 100 m2
Ilinden	221MKD/HH		Category I – 200,00 MKD /month Category II – 250,00 MKD/month Category III – 300,00 MKD/month Category IV – 350,00 MKD/month Category V – 399,00 MKD/month *The tariff system is based on calculating the quantity of waste generated by legal entity, on the basis of the adopted categorization of facilities.*
Petrovets	-		-
Sopishte	TheCouncilhasadoptedapricelistforhouseholdsandapricelistfor wastequantityforcommercialfacilities.		From 490 MKD to 21,000 MKD. *The Council has adopted a pricelist for households and a pricelist for waste quantity for commercial*

		facilities.
Studenichani	-	-
Zelenikovo	Flatrate-189MKDincludingVATperhousehold	11MKD/m²

Costs of waste management system into Skopje region can be divided into collection, treatment and landfill disposal costs. According to Regional waste management plan costs for collection and disposal in total and per tone for 2015 are presented in the table below. Differences in waste collection costs in different municipalities are affected from different factors such as the number of personnel, the collection routes, collection coverage (remote rural settlements), type of trucks and bins (fleet with small capacity trucks and/or not practicable 5m3 containers), etc.

Table 2-19: Waste management costs in Skopje waste management region

	Collection costs MKD/t		Disposal costs MKD/t	
	2014	**2015**	**2014**	**2015**
City of Skopje	7,420	6,792	687	697
Chucher-Sandevo	618	615	-	-
Ilinden	10,299	10,305	303	498
Petrovets	9,512	9,290	-	-
Studenichani	44	44	-	-
Zelenikovo	2,478*	2,479*	-	-

*the collection cost for Zelenikovo municipality refers to total cost (capital and operational)

2.8 Identification of regional possibilities for disposal for different products of WMC (RDF/SRF, compost, CLO, recyclables)

2.8.1 Basics of regional possibilities for CWMF products

Today many wastes and waste fractions are offered for energetic applications. Very often the compositional quality and the environmental parameters are not well described. This poses a risk for producers and users of these fuels as human health and equipment may suffer from certain components in the fuel. As environmental impacts cannot be overseen, public acceptance and acceptance by competent authorities is generally low.

Waste derived fuels generally refer to the production of refuse derived fuels (RDF) and solid recovered fuels (SRF). The terms RDF and SRF are often used interchangeably but there is a significant difference between RDF and SRF which determines its ultimate destination. The preparation of RDF requires a basic level of treatment to remove recyclables from predominantly an MSW waste stream, while SRF requires a higher standard of preparation to produce a fuel. RDF is typically destined for standard Energy from Waste (EfW) facilities which also accept unprepared mixed waste streams. SRF on the other hand are solid fuels prepared from non-hazardous waste and are typically utilized for energy recovery in incineration or co-incineration plants (within cement kilns, power stations, etc.) as an alternative to fossil fuels also meeting the classification and specification requirements laid down in the CEN15359 European standard.

RDF represents a "crude fuel" typically derived from Municipal Solid Waste (MSW) or commercial and industrial waste with similar properties to MSW with a Net CV (Calorific Value) of 8-14 MJ/kg (Mega Joules per kilogram). It is typically pre-sorted and shredded residual waste with recyclables removed where practical, or the reject fraction of a MRF (Materials Recycling Facility) operation.

SRF is produced to a fuel standard specified by the receiving plant and can be produced to the European standard specifications set out in CEN15359:2011. It is typically derived from pre-sorted commercial & industrial (C&I) waste or rejects from MRF activities, and from MSW, typically having a Net CV or >15 MJ/kg.

The development in the production and therefore also use of waste fuels is driven by several factors, these mainly being summarized as:

- EU Landfill Directive 1999/31/EC
- Waste Incineration Directive 2000/76/EC as now superseded by 2010/75/EC,
- Renewable Energy Sources (RES) Directive 2001/77/EC,
- Emission Trading Directive 2003/87/EC,
- Rising energy costs and the consequent interest to substitute
- Development of European Standards (i.e. CEN15359).

RDF and SRF can be used in a variety of ways to produce electricity, heat or a combination of both. It is often used alone or together (as a partial substitute) with traditional sources of fuel in different type of industries. The main outlets of RDF/SRF are currently found in the cement industry as well as paper manufacturing. The European countries where RDF/SRF production is already well established are Germany but also Austria, Finland, Italy, the Netherlands, and Sweden. Countries where RDF/SRF production and energy recovery is currently being developed are Belgium, the United Kingdom and ever more increasingly the eastern European countries for example Slovenia, Serbia, and Croatia. In various countries, several waste derived fuels are produced as different forms of appearance (fluff, pellets, chips, powder).

Regarding the current European market activity, there are cases of importing SRF to Austria or to Germany, some of these being at zero costs at the gate or even with a positive Gate fee (income to the SRF producer) which helps to offset transport costs to these facilities.

A major proportion of the international requirement for SRF utilization (mainly in cement kilns) remains outside of Europe, for example in India and China, these two countries being of the largest producers of cement globally. Any consideration for the export of SRF materials to these regions brings with it other costs (road, port storage/handling, shipping) and regulatory issues. China in particular is globally recognized as a dominating force in global manufacturing specifications and the treatment of recyclables due to being the largest importer of recyclables, also from Europe. Shipments however of SRF from Europe to China or India are not almost nonexistent due mainly to their relatively low (in comparison to recyclables) market value in relation to their transportation costs. No notable figures for exports of SRF from European countries to Eastern and South Eastern markets were established.

It must be noted that quality management for RDF/SRF plays a key role in efforts to establish viable market outlets, not least by creating confidence in suppliers, end-users, and regulators. However, standardization in isolation cannot guarantee increased market share.

The European market for SRF/RDF is developing and remains unpredictable. The RDF/SRF contaminant properties and combustion behavior critically affect its potential applications. Problems with low-quality RDF characteristics, particularly high chlorine and trace metals content, have led to a decline in co-combustion applications.

In the framework of the study area, only one (1) cement plant is in operation in the Beneficiary country (Usje Cementarnica, which is a 94.8% subsidiary of Titan Cement Company of Athens).
On the basis of the specified quality, a producer can then declare the quality of his fuel using the SRF classification scheme. This scheme has the mere function of providing for an easy and uniform language between producer, client and other stakeholders. The classification scheme uses three major parameters: calorific value (economic information), chlorine (technical information) and mercury (environmental information). Using limit values for these three parameters the overall quality and value of a SRF can quickly be assessed (see standardization of SDF document).

The price of produced product depends on the quality. SRF of class 2 or higher, based on the above-mentioned classification system, could be cost -5€/tone (that means the producer should pay 5€/tone to a cement plant). SRF of lower class could be cost up to -20€/tone.

Additionally, the material must not contain pieces of metal or stone that can damage the conveyor systems and must not contain dioxins, furans, PCBs and other hazardous organic components. According to the European Waste Catalogue (EWC) SRF must be declared within the category 191210.

2.8.2 Regional possibilities for compost

The marketability of Compost-like outputs (CLO) is affected by the concentration of contaminants. Some facilities in Europe are processing mixed waste (composting and anaerobic digestion) with the intent of recovering a product suitable for landscaping and for use by the agricultural sector. Compost-like outputs (CLOs) are treated differently across Member States. For example, Germany uses MBT mostly as a pre-treatment prior to landfill, partially to stabilize biodegradable municipal solid waste, and does not use CLO on land. In France there are 70 plants processing 1.9 million tons per annum (tpa) of MSW with CLO used on land. Other countries also have substantial MBT capacities and use some of the CLO output on land, including agricultural land, such as Spain which has treatment capacity of 3 million tpa and Italy which has treatment capacity of 11.7 million tpa. In the UK the current regulatory position precludes the use of CLO from mixed waste sources for any agricultural land.

CLO derived from mixed waste is of lower quality and value compared to compost derived from source-segregated materials, largely due to higher contamination levels. Trials on mixed waste derived materials have reported large amounts of physical contaminants (e.g. glass) and potentially levels of other elements above limits.

Potential uses of the produced CLO can be:

a) As the fill material or material for soil remediation for the following tasks in projects or activities:
    - To active mining operations, for filling and rehabilitation of trenches whose operation has been completed,
    - In road works and particularly in concrete trenches on slopes or embankments in closed highways for vegetation growth,
    - As material for landscaping, provided that the final surface sealing of the new waste surface will be consisted of planting of at least one (1) meter thickness,
    - As daily and final cover material in landfills,
    - In backfilling operations
    - soil remediation in inactive, for rehabilitation mines and quarries.
    - As a top soil material for recovery of waste Dumpsites.
b) As a biofilter material for absorbing odors from industrial plants with smelly waste gas vents in municipal sewage treatment plants, mechanical sorting, and composting, mass conservation animals, etc.

Regarding the consideration of *compost as a multifunctional soil improver*, it is therefore used in agriculture and horticulture. The application of compost usually improves the physical, biological and chemical properties of soil. Repeated application of compost leads to an increase in soil organic matter, it often helps to reduce erosion, it increases the water retention capacity and pH buffer capacity, and it improves the physical structure of soil (aggregate stability, density, pore size). Composts may also improve the biological activity of the soil.

Regarding the often consideration of *compost as an organic fertilizer*, that function of compost (supply of nutrients) is, in many cases, less pronounced than the general soil improvement function.

The second main use of compost is as a component of growing media. Growing media are materials, in which plants are grown. The total volume of growing media consumed in the EU is estimated to be about 20–30 million m^3 annually. Worldwide, peat-based growing media cover some 85–90 % of the market. The market share of compost as a growing medium constituent is below 5 %.

The suitable uses of compost depend on source material type, compost class and quality. Application areas like agriculture just require standard quality. Landscaping and, even more so, the growing media sector need an upgraded and more specialized product. Here, further requirements have to be met and it is up to the marketing strategy of the compost plant to decide whether to enter into this market segment.

In Europe, more than 50 % of the compost goes to mass markets which require standard quantities. Twenty to thirty per cent of the market volumes are used in higher specialized market areas which require an upgrade and mixing of the compost in order to meet the specific requirements of the customers.

The classification system for compost, based on the EU regulation on by-products and end-of-waste status is presented at the following table:

Table 2-20: Compost classification system

Parametar	Limit values in compost		
	Class I	Class II	Class III
	mg/kg dry matter		
Cadmium (Cd)	0.7	1	3
Chromium (Cr)	70	150	250
Mercury (Hg)	0.4	0.7	3
Nickel (Ni)	25	60	100
Lead (Pb)	45	120	200
Copper (Cu)	70	150	500
Zinc (Zn)	200	500	1800
PAU	-	-	6
PCB	-	-	1

Permitted uses of the produced compost according to the class belonging is the following:

Compost Class I: is designed for use in organic production in accordance with the special regulations for organic production and use in agriculture in accordance with the special regulations for fertilizers and soil improvers;

Compost Class II: is designed for use in agriculture in accordance with the special regulations for fertilizers and soil;

Compost Class III: is designed for use on the ground that is not used for food production, the forest and decorated park land, for the purposes of planning and land reclamation and for the final layer for landfills recultivation. In addition criteria for processing is the AT4 (AT4 is an analytical method that needs to be carried out according to BS EN 15590: 2011 Solid recovered fuels) respiration index: The AT4 is a static respiration index (SRI) test, also used to calculate the oxygen consumption of a sample over a period of time. The index determines the biological stability of compost or other organic materials, and is an additional test to prove the maturity of the material being tested.

2.8.3 Regional possibilities for recyclables

The processing of quality secondary materials is needed to ensure the sustainability of the recycling sector i.e.through source separated collection and imposing standards for the processing of packaging waste. Pakomak is the first company in the Beneficiary country, licensed by the Ministry of environment for selection and processing of packaging waste.

The recyclables derived from the recovery of mechanical treatment of mixed waste can add benefit to the recycling industry and used as a substitute for raw materials to reinforce the local manufacturing industry, as well as the financial conditions of the area. Industrial activities that use recyclables as raw materials in their processes regard paper manufacturing, glass manufacturing and steel manufacturing.

In particular, other indicative applications of recyclables in industry refer to:

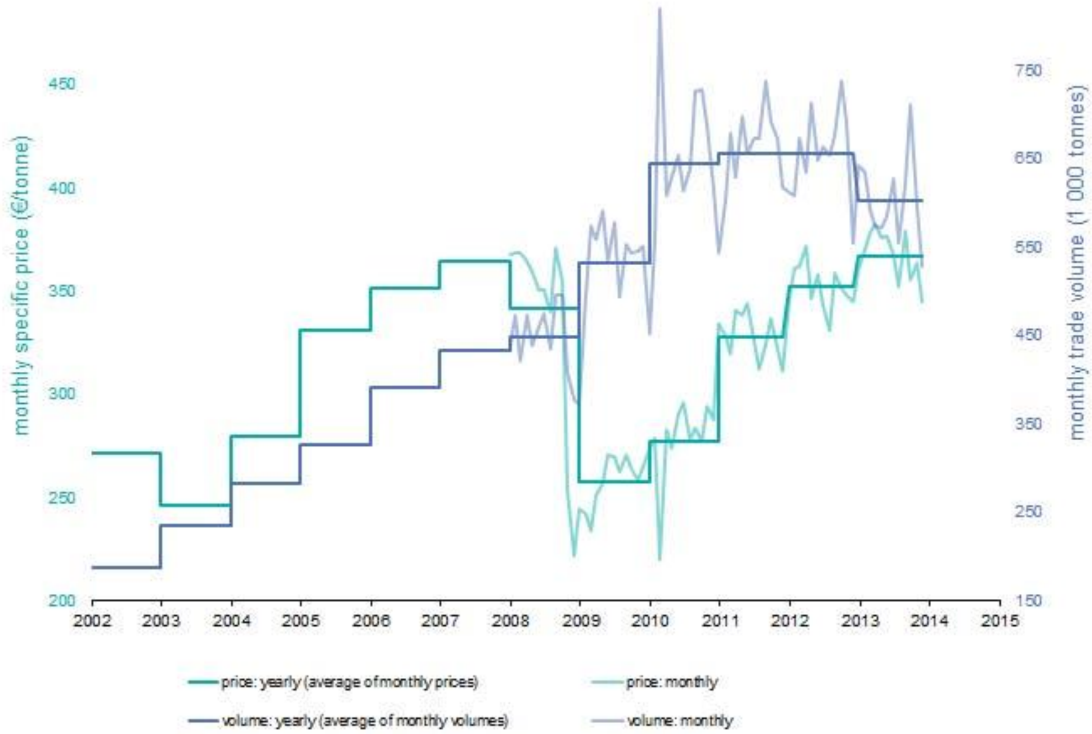
- Installations for the production of iron or steel
- Ferrous metal foundries and melting installations
- Installations for surface treatment of metal and plastic materials electrolytic or chemical process
- Installations of Mineral industry
- Wood and paper industries
- Other facilities

The conditions exist for an increased use of secondary raw materials in the manufacture of new packaging due to the good quality and sufficient quantities available.Thegraphbelowshowsannualaverages ofmonthly pricesandvolumes ofplasticwasteintheEU28 countries,givenfrom2002to2013,accordingtothewebsitewww.letsrecycle.com. From2009only,the dataisalsodisplayedonamonthlybasistohighlightfluctuationsinthedata(transparentlines).

The traded volume (blue line) tripled over the reported period from the year 2002 to 2012 from approximately 180 000 tons/month to nearly 650 000 tons/month. The monthly data (transparent blue line) show a volatile steady increase until 2011/2012. 2013 was the first year since 2002 in which the annual trade volume did not grow and the trade volume 2013 was lower than the year before. Within a year the volatility is also significant. For 2013 the monthly average for the whole year is approximately 600 ktons. We observe a spike in September 2013 of approximately 710 ktons and a drop to 523 ktons in December 2013.

The price of plastic waste depends on one hand on the supply and demand of plastic waste material and on the other hand on crude oil price which strongly influences the price of the virgin (primary) material. The indicator (turquoise line) shows a decrease in the price of plastic waste between 2003/2004. Since 2004 the price has increased to levels above 350 €/t. In 2009 the indicator shows a sharp decline down to 234€/t inMarch 2009. Afterwards the price recovered with the exception of March 2010 when the lowest price in the decade with 220€/t is shown (monthly data in transparent turquoise line). Finally, the price recovered to the price level of 2007 with around 370€/t.

Figure2-25:PricedevelopmentsofplasticwasteEU-28(€/ ton)

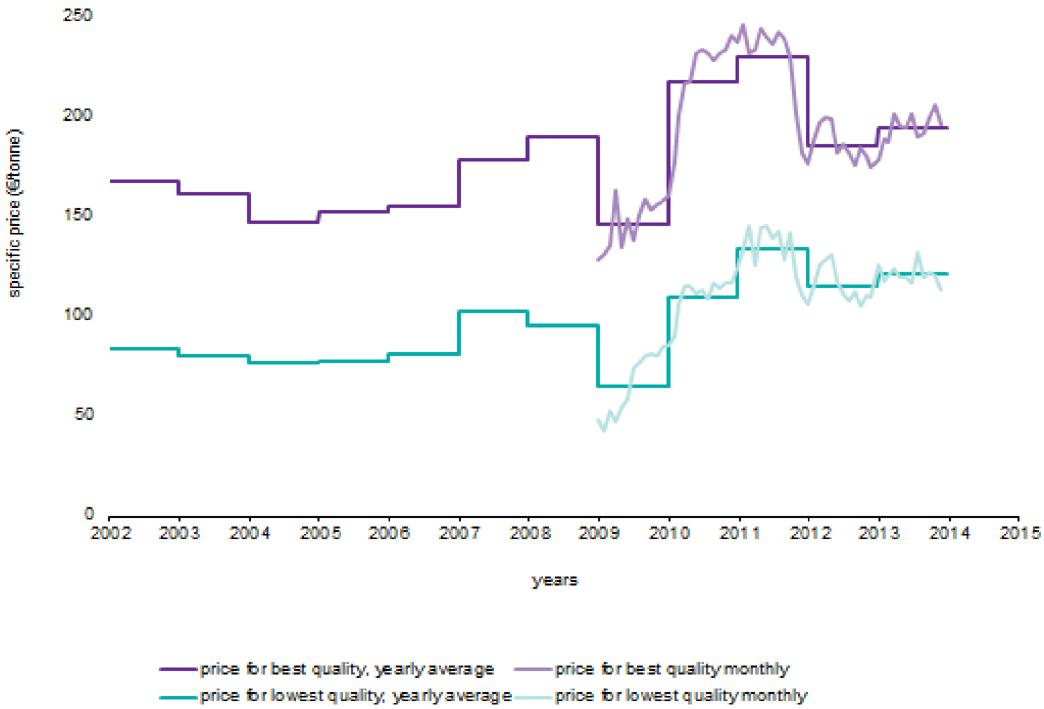


Source:http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Price_indicator_and_trade_volume_for_plastic_waste_in_EU-28_till_December2013_update3.PNG

For paper and plastics more than one foreign trade statistics code is used for the calculation of the price indicator. The different codes describe secondary materials, which may include industrial residues of high quality or separately collected waste. Figure 2-26 illustrates the difference in price and the corresponding development over time. As an example, the trade positions of paper waste with the highest (code 47072000) and lowest (code 47079010) price were chosen. The difference in price between the lowest and highest quality remains fairly constant. In other words, both prices appear to develop in parallel. The observation of trade volumes gives a similar picture. Therefore, it is reasonable to calculate only one price indicator for paper.

Overall, local separation of the recyclable stream and delivery to a commercial buyer will remain only opportunistic in nature and cannot be relied upon in terms of stability of revenues or cost. Another factor to consider is that buyers need large consistent amounts of recyclables to be viable; they want guarantees that the materials will always be available in the quantities required. Local Authorities cannot guarantee this. Setting up public private partnerships, or making contracts with private companies can help local authorities achieve 100% waste collection. However, municipalities may need assistance to ensure appropriate contracts are established and are supported by legislation.

Figure2-26:PricedevelopmentofIowandhighqualitypaperwasteinEU-28untilDecember2013



Source:http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Price_development_for_low_and_high_quality_paper_waste_in_EU-28 _till_December2013_update4.PNG)

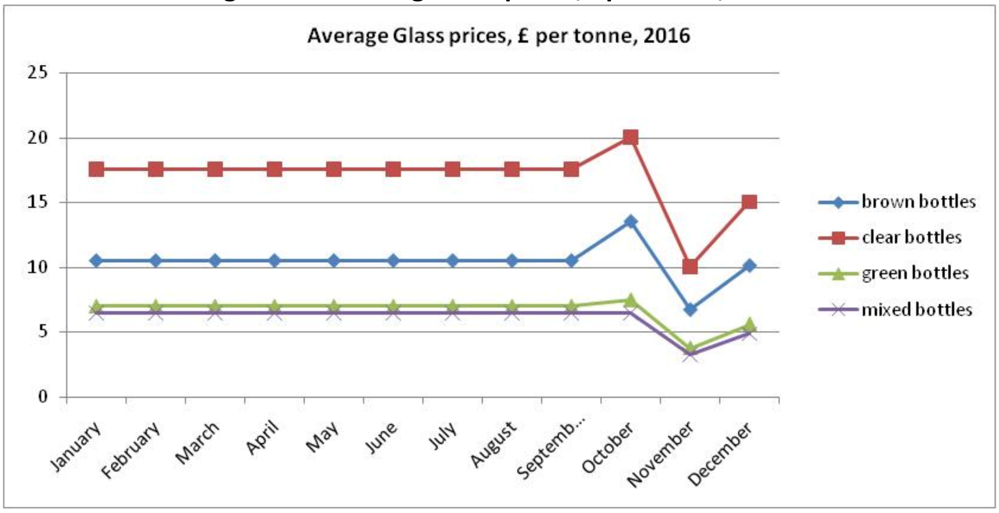
Development in the sectors of collection and recycling create business and employment opportunities. Development of the local market to take recyclables is a key opportunity to help support the establishment of a viable recycling sector.

The following graph presents the fluctuation of glass prices in UK for the year 2016, according to the website www.letsrecycle.com. It must be noted that the prices shown are for tonnages of container glass (essentially bottles and jars) delivered to a cullet collector who will clean and sort the glass ready for use, or for further checking, by a glassmaker.

The guide price for mixed glass typically reflects the sum that may be paid at the weighbridge by the aggregates sector and some glass industry recyclers for the mixed material. It must also be taken into account that the quality of mixed glass varies.

According to the website, some believe that including glass in commingled collections makes it harder to separate from other materials at MRFs, meaning for some that MRF glass is not of such a high quality compared to separated mixed glass

Figure2-27:AverageGlassprices,£ pertonne,2016



(Source:http://www.letsrecycle.com/prices/glass/glassprices2016/)

According to the site www.letsrecycle.com, UK glass manufacturers prize clear glass most highly because, while most glass made in the UK is clear, by far the largest proportion of the glass waste stream is green. For this reason, green is prized the least. Completely mixed glass cannot be used in the container re-melt industry, where colour purity is vital, and must instead go to alternative uses such as aggregates. However, companies abroad in wine-producing countries such as Italy, Spain and Portugal are willing to import mixed glass to process green container glass. These countries are the main recipients of exported UK glass, which is then used to create wine bottles. For mixed and clear glass, comparative prices are presented in the table below for years 2016 and 2015.

Table2-21:MixedandClearGlassprices,£ perton,2016-2015

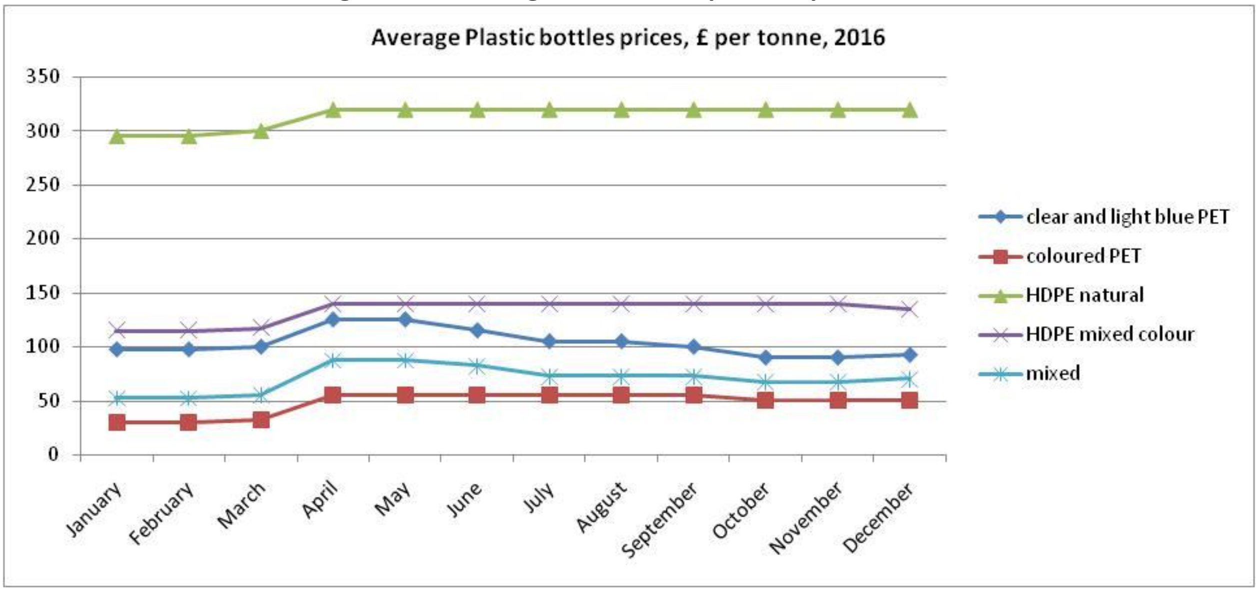
	2016				2015			
MONTH	MIXED GLASS		CLEAR GLASS		MIXED GLASS		CLEAR GLASS	
	Low	High	Low	High	Low	High	Low	High
J	0	13	10	25	-10	10	14	23
F	0	13	10	25	-15	10	16	25
M	0	13	10	25	-30	10	16	25
A	0	13	10	25	-30	10	16	25
M	0	13	10	25	-30	10	16	25
J	0	15	12	25	-25	10	16	25
J	0	15	13	23	-30	15	16	25

A	0	15	15	25	-33	15	16	25
S	0	13	15	25	-33	15	16	25
O	0	13	15	25	-35	11	14	22
N	0	13	15	25	-31	9	14	22
D	4	17	17	27	-30	10	15	23
AVERAGE	0	14	13	25	-28	11	15	24

(Source:http://www.letsrecycle.com/prices/glass/glass-prices)

The following graph presents the fluctuation of plastic bottle prices for the year 2016, according to the website www.letsrecycle.com. According to the site, reprocessors will normally only accept material in baled form. The current preferred bale form is 1.8m x 1.2m x 1m, with larger bales too big to be handled byreprocessors' bale-breaking equipment and smaller balers difficult to store. Bales should be compacted to a density which ensures safe stacking, loading and transport and allows for separation of the bales once the strapping is removed. There is variation in bale weights depending on polymer type. Based on the specified bale dimensions, bales should weigh between 200- 325 kg. There are limitations to the maximum bale density which some reprocessors can accept. Only plastic bottle materials shall be baled. Other materials such as cardboard end pieces or plastic film wrapping should not be used.

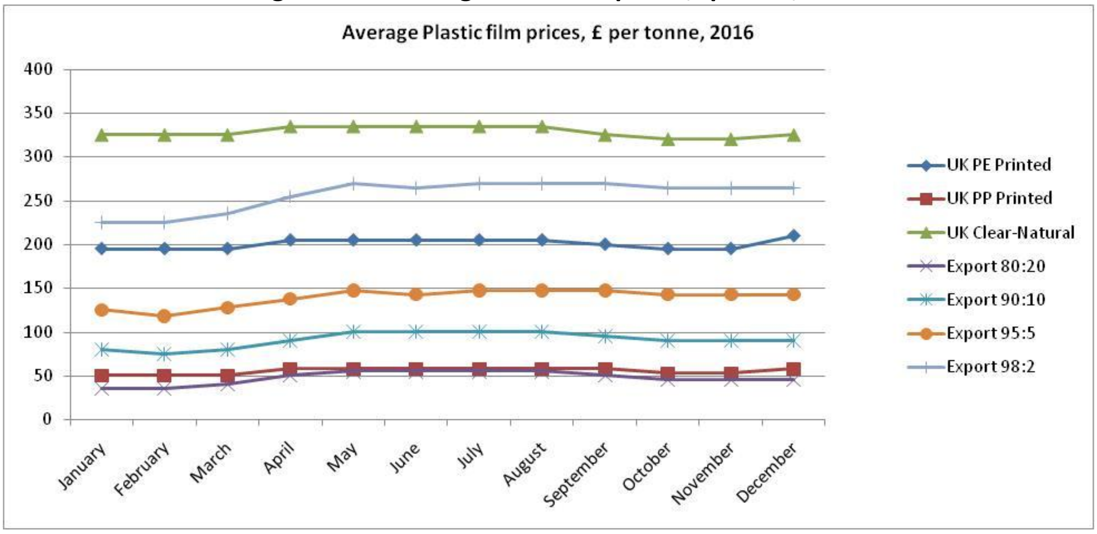
Figure2-28:AveragePlasticbottleprices,£ perton,2016



Source:http://www.letsrecycle.com/prices/plastics/plasticbottles/plasticbottles2016/)

Regarding plastic films, two main types of plastic film are traded within the UK and most of the film is exported for processing, and in particular to China. While hand-sorting and processing is carried out overseas and some contaminated material will still be recycled, the general principle for plastic film recycling is that the material should be as clean and contaminant-free as possible. Material is usually expected to be baled in various grades, including natural and jazz; weights are either light or heavy; and in various grades of contamination, from little through to heavily contaminated.

Figure2-29:AveragePlasticfilmprices,£perton,2016



Source:http://www.letsrecycle.com/prices/plastics/plasticfilm/plasticfilm2016/1/

For mixed plastic bottles and plastic film (PP-PE printed), comparative prices are presented in the table below for years 2016 and 2015.

Table2-22:PlasticbottlesandPP-PEprintedprices,£perton,2016-2015

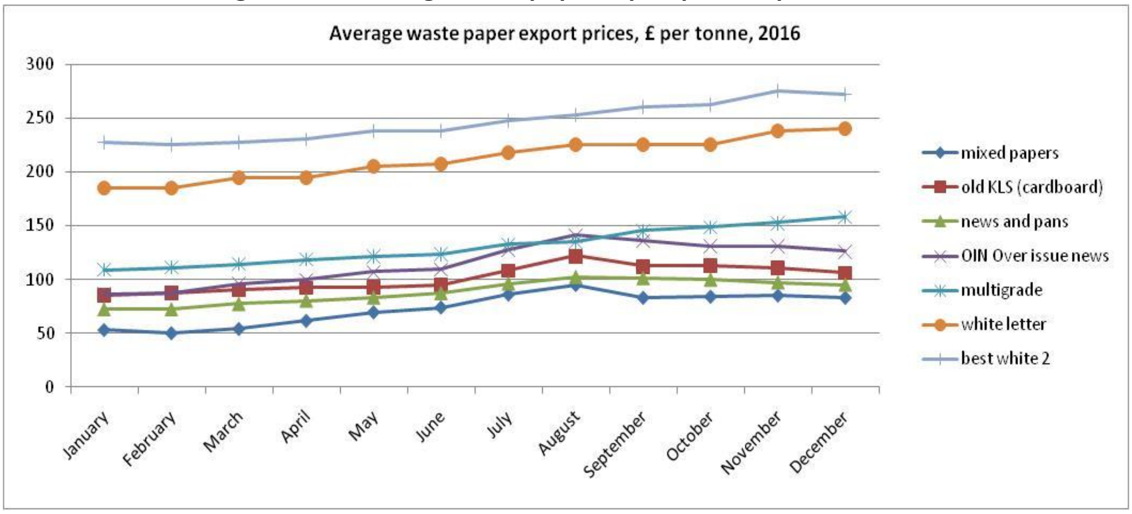
	2016						2015					
MONTH	PLASTIC BOTTLES (MIXED)		PE Printed		PPPrinted		PLASTIC BOTTLES (MIXED)		PE Printed		PPPrinted	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
J	30	75	180	210	35	65	65	105	210	230	65	85
F	30	75	180	210	35	65	70	110	210	240	65	85
M	30	80	180	210	35	65	70	110	210	240	65	85
A	55	120	190	220	45	70	70	110	210	240	65	85
M	55	120	190	220	45	70	80	120	220	250	75	95
J	50	115	190	220	45	70	80	120	225	255	80	100
J	40	105	190	220	45	70	80	120	225	255	80	100
A	40	105	190	220	45	70	50	90	210	235	60	85
S	40	105	185	215	45	70	35	75	200	230	45	65
O	35	100	180	210	40	65	35	75	200	230	45	65
N	35	100	180	210	40	65	35	75	200	230	45	65

D	40	100	195	225	45	70	35	75	200	230	45	65
AVERAGE	**40**	**100**	**186**	**216**	**42**	**68**	**59**	**99**	**210**	**239**	**61**	**82**

The following waste paper export guide prices, compiled by letsrecycle.com, – in £ per ton – indicate what may be paid for material but are not guaranteed. Price indicators are for material ex work, usually baled or supplied to a mill specification.

In January 1999 UK paper mills and suppliers started to adopt the new European Standard grade list compiled by the Confederation of European Paper Industries (CEPI) which was used as the basis for the revision of the European Standard EN 643. There was much discussion in the UK in 2003 over the use of material collected on a commingled basis from households. By 2010 it appeared that most UK paper mills using material from the domestic stream were taking in some material from commingled collections.

Figure2-30:AverageWastepaperexportprices,£perton,2016



Source:http://www.letsrecycle.com/prices/wastepaper/exportprices/2016exportprices/

For mixed paper and cardboard, comparative prices are presented for years 2016 and2015.

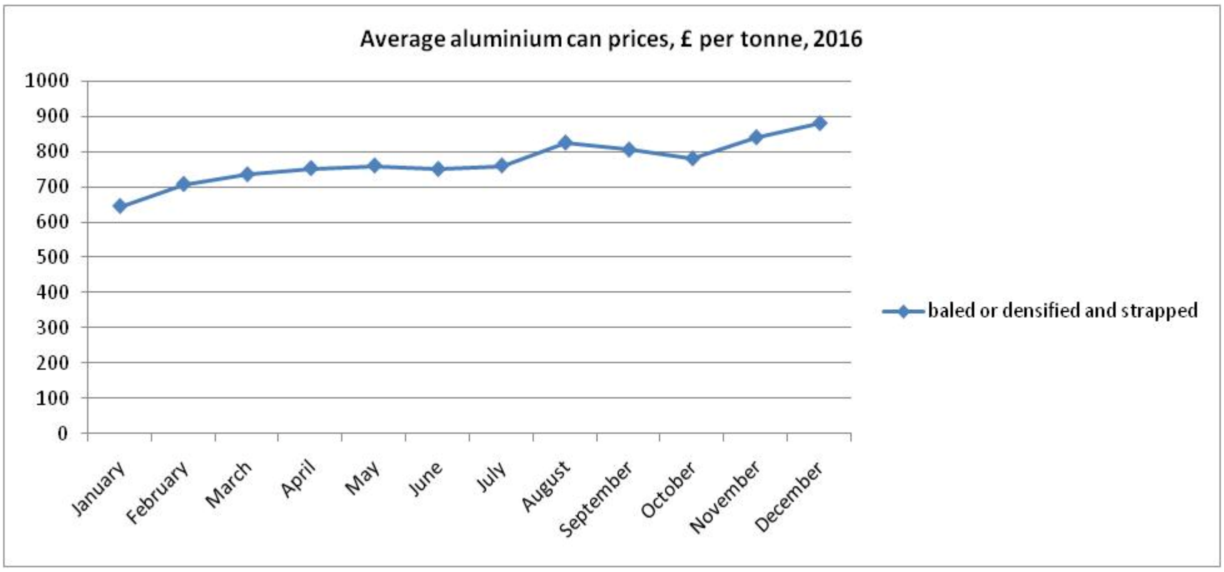
Table2-23:Mixedpaperandcardboardprices,£ perton,2016-2015

	2016				2015			
MONTH	MIXED PAPER		CARDBOARD		MIXED PAPER		CARDBOARD	
	Low	High	Low	High	Low	High	Low	High
J	50	56	83	88	47	55	77	80
F	46	54	85	90	46	52	74	78
M	48	60	87	94	45	50	78	80
A	56	67	90	95	46	53	79	82
M	65	74	90	96	47	57	82	90
J	70	78	94	96	55	66	86	92
J	80	92	105	112	60	73	83	91
A	90	100	119	125	60	68	82	87

S	78	88	110	115	55	67	81	86
O	80	88	111	115	55	71	80	85
N	80	90	108	114	55	69	80	84
D	78	88	102	111	55	62	81	84
AVERAGE	**68**	**78**	**99**	**104**	**52**	**62**	**80**	**85**

The following aluminum cans prices, compiled by letsrecycle.com, – in £ per ton, serve as an indicator to current markets, but are not guaranteed. The following graph presents aluminum can prices for year 2016.

Figure2-31:AverageAluminumcansprices,£ pertonne, 2016



(Source:http://www.letsrecycle.com/prices/metals/aluminium-cans/aluminium-can-prices-2014)

For aluminum cans, comparative prices are presented in the table below, for years 2016 and 2015.

Table2-24:Aluminumcansprices,£ perton,2016-2015

MONTH	**2016**		**2015**	
	Low	**High**	**Low**	**High**
J	620	670	740	810
F	675	740	720	810
M	700	770	740	820
A	730	775	740	820
M	740	780	755	835
J	730	770	700	770
J	740	780	640	680
A	800	850	625	660
S	780	830	580	640

O	760	800	590	630
N	820	860	610	660
D	860	900	620	670
AVERAGE	**746**	**794**	**672**	**734**

2.9 Collection, treatment and disposal service

The waste management system is based mainly on waste collection and disposal. The waste collection, transportation and disposal service is provided by Public Utility Enterprises (PUEs). Waste disposal is provided by the PUEs at the regional municipal landfill sites. The sites are operated on a controlled basis, but they are not compliant with EU requirements. Uncontrolled dumpsites exist, especially in rural areas, which are not covered by the waste collection system. There are 72 companies, which have licenses for waste transport and storage in Skopje waste management region.

Collection

The Municipalities hold the overall responsibility for waste management and the Public Utility Enterprises (PUE) are the main service provider of waste management services conducting the daily operation of waste collection services and landfill of waste. Currently, the municipalities hold the overall responsibility for waste management and the PUEs are the main service providers of waste management services conducting the daily operation of waste collection services and landfill of waste. PUE "Komunalna Higiena" (PEKH) is a unit within the City of Skopje, Department of Municipal Affairs responsible for ensuring communal hygiene, maintenance and use of parks and greenery. It collects and transports the household waste from nine of the Municipalities of the City of Skopje. There are also several private companies (PC), which collect and transport waste from semi-urban and rural Municipalities. In the Municipality of Sopishte, PAKOMAK Company (Consortium) is responsible for collection and transportation of packaging waste in all 13 settlements of the municipality (100% population serviced).

Table 2-25: Collected waste and collection coverage in Skopje region

Skopje Region	Total collected waste, 2016 (t)	Collection coverage %
City of Skopje	139,802	95
Arachinovo	2,028	60%
Chucher-Sandevo	1,457	80
Ilinden	2,734	100
Petrovets	672	30
Sopishte	1,198	100
Studenichani	1,800	50
Zelenikovo	930	73
TOTAL	**150,621**	**92**

In the Municipality of Gjorche Petrov, "Eko-Flor" Company (private) is in charge of the collection and transpiration of waste. "Eko-Flor" is the responsible company for waste collection in rural area of the municipality, which is 10,607 inhabitants, or 25% of population, based on the agreement with the municipality. In the Municipality of Shuto Orizari, DTT "SH Reviel" Skopje (private company) is in charge of the collection and transportation of waste. The company serves only one settlement, v. Gorno Orizari.

The frequency of collection from households and commercial entities in that village is twice a weekend covering 90% of the population (450 inhabitants). Municipalities Aracinovo and Petrovets dump their waste on illegal dumps. In the following table, data on totally collection waste and collection coverage are given.

Separate collection of recyclable MSW fractions is not established and there are no specific door-to-door collections of segregated recyclables. Recyclable materials are collected by individual private companies, collections from scrap yards and informal recovery (scavenging). Scavenging of waste is prevalent across the city of Skopje Primarily the focus of the scavenging is on the collection of plastic waste fractions from 1.1^3 mcontainers placed in the municipalities in the city of Skopje. Although they will also collect paper, metal etc. There is a well-established network of collectors and/or brokers for recovered scrap metals, as well as a strong and stable market. PET is not collected by the scrap yards mostly because of the costly collecting system due to big volume of PET bottle and low weight.

Treatment

Formalised waste recycling is not particularly well established in Skopje and there is no significant presorting by the households. There is currently a scheme to roll out bring sites across Skopje which will receive plastic wastes. Informal recycling through scavenging is prevalent and the norm for the region. Paper recycling is undertaken from individual commercial and public premises; there are individual containers located around Skopje for the public to use and large containers at specific industrial outlets. Small quantities of PET bottles (39 t in 2010) and paper (15 t in 2010) were placed in specialized bins managed by PUE "Komunalna Higiena" which are spread around the City area. The main factory for paper and cardboard in Skopje "Komuna Ad" is understood to be in a phase of reorganization. In the rural areas, organic waste is used as food for small animals or poultry. Paper and cardboards are used as fuel for heating and cooking in the rural areas. The quantity of wastes disposed of within the households is unknown.

Disposal

The primary disposal options in Skopje waste management region are landfilling without any pre-treatment. The majority of generated waste is disposed on non-sanitary landfills. The greatest share is directed into Drisla landfill site, which covers the area of 76 hectares, and where 55hectares are used for landfilling. This is the only legal landfill operating in the country and it receives around 150.000 tons of waste per year. This landfill does not have appropriate environmental infrastructure, e.g. proper lining and a drainage system to prevent polluted leachate entering the groundwater and a methane recovery system.

The site does have a non-compacted clay-based layer in the base of the site. Also small uncontrolled landfills or so called “dumpsites” constructed without any engineering or other control measures for environmental protection were identified in 15 of the municipalities. In total, 57 dumpsites exist within Skopje Region territory. Additional 2 were closed in the last 20 years. Out of 59 landfills and dumpsites, 6 (10%) are evaluated as a high risk and 50 (85%) as medium risk and 3 (5%) as a low risk sites. Most of the sites (47) can be reclaimed with waste removal (cleaning), 9 will be capped without gas control installation and 3 capped with gas control installation.

2.10 Review of the adopted Regional Waste Management Plan for Skopje Region

The RWMP for Skopje was drafted in November 2016 on the basis of: a) EU and national waste legislation and strategies, which include objectives, set out in specific areas; and b) the analysis and evaluation of the current situation, which was the outcome of the elaborated Assessment Report. Apart from the EU and national waste legislation and strategy, there are a number of significant parameters which influence the regional planning and were taken into account: (1) Waste quantity and composition, (2) Geographic origin of the waste and (3) Current situation regarding waste collection and treatment, including waste tariffs and affordability.

A waste qualitative and quantitative survey had been performed during the elaboration of the Assessment Report. According to the waste qualitative survey the total organic waste in this region has been calculated in 42.3% and the total recyclables in 39.5%. The fractions textile-leather-wood and other special waste streams (elastic - tyres etc) have a share of 7.6%, diapers 6.1%, construction and demolition waste 1.7%, hazardous materials (medical waste) and WEEE 0.6%, and fine fraction 2.2%. According to the waste quantitative survey, in Skopje Region, the total collected waste for year 2016 was 150.621 t and the total generated waste was calculated to 162.883 t. The collection coverage has been calculated to 92%. The waste generated rate for Skopje Region has been calculated to 262 kg/ca/year.

In order to calculate the waste generation forecast (2017-2046) for the region the following steps have been followed: (1) the forecasting of the population (permanent and seasonal) has been implemented for years 2017-2046 taking into consideration data regarding the average annual change of permanent population from World Bank and data concerning the average annual change of seasonal population from National Tourism Strategy 2009-2013, (2) four scenarios regarding the forecasting of waste generation rate from permanent population have been quantified and compared (the chosen scenarios have been proposed in NWMP) and scenario 2 eventually preferred, (3) the assumption that the waste generation rate of seasonal population will be 1.2 kg/bednight has been used, (4) multiplying each population with the corresponding waste generation rate the generated waste has been estimated for years 2017-2046. The generated waste for Skopje Region (from permanent and seasonal population) has been calculated to 165.725 t in 2017 and 188.456 t in 2046 (average 2021-2046: 186.692 t/y).

With the Regional Waste Management Plan the minimum requirements set by the national waste management legislation for packaging and packaging waste were covered, as well as targets for biodegradable municipal waste (BMW) that should be diverted from landfills, in particular:

- Total recycling of packaging waste: min 55% - max 80% to be achieved by 2020
- Recycling of materials of packaging waste: (1) glass 60% to be achieved by 2020, (2) Paper and cardboard 60% to be achieved by 2020, (3) Metals 50% to be achieved by 2020, (4) Plastic 22.5% to be achieved by 2018 and wood 15% to be achieved by 2020
- Reduction of the quantity of Biodegradable municipal waste (BMW) landfilled expressed as a percentage reduction of the BMW generated in 1995: (1) at least 25% until 2017, (2) at least 50% until 2020 and (3) at least 65% until 2027

In Skopje region, a semi compliant municipal landfill already exists (Drisla Landfill). Taking into consideration that it has already been determined the treatment technology of municipal solid waste in this region, in the RWMP only alternative scenarios concerning collection system of solid municipal waste were examined. Three main alternative scenarios have been examined and presented via a flow diagram. All proposed scenarios included some common elements like (i) green points that will be collection points for recyclables and wood packaging fraction, (ii) separate collection of hazardous municipal waste, (iii) separate collection of construction and demolition waste, (iv) separate collection of WEEE and (v) separate collection of other special waste streams (elastic-tires). Also all proposed scenarios included separate collection of garden waste and sorting at source of recyclables or packaging waste. Finally the alternative scenarios included a collection system with the use of either 1 or 2 or 3 bins.

Scenario 1: Collection of mixed waste in one bin collection system (mixed waste) that is transferred to Mechanical Biological treatment plant with biodrying process. Also includes separate collection of green waste that is treated to a windrow composting process (production of compost), home composting actions (compost production), green points (collect small amounts of recyclables and wood), separate collection of construction and demolition waste, hazardous fraction of waste, WEEE and other special waste streams like elastic-tires and sorting at source for packaging waste from collective schemes.

Scenario 2: Collection of recyclable waste in one bin that is transferred to a Material Recycling Facility and collection of residual waste in another bin (mixed waste bin) that is transferred to Mechanical Biological treatment plant with biodrying process. Also includes separate collection of green waste that is treated to a windrow composting process, home composting actions, and green points (collect small amounts of recyclables and wood), separate collection of construction and demolition waste, hazardous fraction of waste, WEEE and other special waste streams-elastic, tires.

Scenario 3: Collection of recyclable waste in one bin that is transferred to a Material Recycling Facility, collection of organic waste in another bin (organic waste bin) that is transferred to an aerobic composting (production of compost) and collection of residual waste in a third waste bin (residual waste bin) that is transferred to Mechanical Biological treatment plant with biodrying process. Also includes separate collection of green waste that is treated to the same aerobic composting plant with organic waste (from organic waste bin) and produce compost, and green points (collect small amounts of recyclables and wood), separate collection of construction and demolition waste, hazardous fraction of waste, WEEE and other special waste streams-elastic, tires.

All the above examined scenarios fulfilled the legislative targets concerning recycling of packaging waste and reduction of Biodegradable municipal waste which will be diverted to landfill.Apart from the quantification of targets for each examined scenario concerning recycling of packaging waste and reduction of biodegradable municipal waste landfilled, estimations of investment cost, operational cost, revenues, net operational cost and dynamic prime cost have been done.

Considering all the elements which have been presented in various chapters of the RWMP, the recommended waste management system for Skopje region was scenario Sc. 2. The total investment cost of the recommended scenario is approximately 11 mil € (without contingencies and VAT), the total operational cost is approximately 11.6 mil €/y (average 2021-2046) and the levelized unit cost have been calculated to70.61 €/t.

Regarding the quantification of targets of recycling of packaging waste and reduction of biodegradable municipal waste which will be landfilled in years 2021 and 2027 (expressed as a percentage of biodegradable municipal waste produced in 1995) for the selected scenario 2 the following figures have been calculated: (i) total % of recycling of packaging waste 55.08%, (ii) % glass packaging recycling 62.78%, (iii) % plastic packaging recycling 50.53%, (iv) % paper packaging recycling 62.78%, (v) % Fe packagingrecycling 51.50%, (vi) % Al packaging recycling 51.50%, (vii) % Wood packaging recycling 15.00%, (viii) Reduction of biodegradable municipal waste landfilled in 2021 75.91% and Reduction of biodegradable municipal waste landfilled in 2027% 75.76%.

In total, 57 dumpsites were identified within Skopje Region territory. There are applied 3 models of landfill remediation and the total cost (indicative) for the rehabilitation of these landfills has been estimated.

Having set the regional targets and objectives as well as the measures via which these targets will be achieved in the previous paragraphs, an action plan for the proposed interventions was prepared. This plan focuses on the priority measures and the respective main infrastructure investments, but it also gives an indication of all future activities (reinvestment or other activities) that will need to be implemented. The Action Plan is divided into the following periods: (1) Priority measures for a period of up to three years (2018-2020), (2) Short-term measures for a period of up to five years (-2022), (3) Medium-term measures for a period of six to ten years (-2027) and (4) Long term measures for a period longer than ten years (-2046).

3. SOCIO - ECONOMIC CONTEXT

3.1. Permanent population – current status and future projections

According to the data from the last Census of Population, Households and Dwellings in 2002, the Skopje Region had 578144 inhabitants. According to the sixth edition of "Regions of the Republic of Macedonia, 2015" population estimates from the State Statistical Office, the overall population of SkopjeRegion has increased (619279inhabitants in 2014), as well as the overall population of the country.

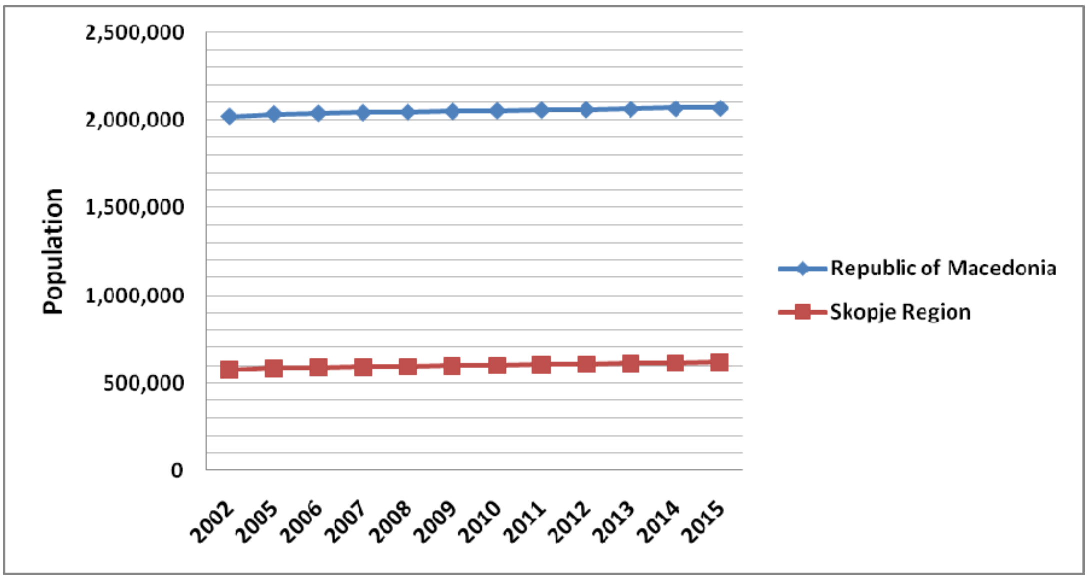


Figure 3-1: Population 2005-2015, according to estimates

Population changes are usually a result of the direct influence of natural changes (births and deaths) and mechanical changes (migration). The demographic indicators at regional level show considerable differences among them. This fact points to a big disproportion in the territorial distribution of the population.

Skopje Region is the smallest as it covers only 7,3% of the total land area of the country. With 339,7 people per km^2 and 29,8% of the country’s total population (2014), it has almost ten times higher density than the Vardar Region, which is the least densely populated. This region is the main hub of the country and has the most developed traffic infrastructure.

Most of the country’s industrial, trade and service capacities are concentrated in this region. Skopje, the capital of the Republic of Macedonia, is located in this region, and it is the economic, administrative, cultural and academic center of the country. As a result, regarding the internal migrations, this region represents the largest immigration area The following table presents basic demographic date for the Region.

Table 3-1: Basic demographic data, Skopje Region, 2015

Numberof municipalities	17
Numberof settlements	142
Total population,Population Census, 2002	578,144
Estimatedpopulation, 2015	619,279
Populationdensity, 2015	341.6
Numberof dwellings, Population Census, 2002	188,394
Averagenumber of persons per household,PopulationCensus2002	3.5
Live births, 2015	8,043
Deaths,2015	5,829
Natural increase,2015	2,214
Immigrants from abroad, 2015	1,773
Emigrantsto abroad, 2015	73
Numberof beds, 2015	6,089
Numberof tourists,2015	234,123
Numberof nights spent,2015	452,912

(Source: State Statistical Office (2016) (Regional Yearbook 2016, ISSN 1857-6141)

Table 3-2: Population of Skopje Region Municipalities (Census 2002 and estimation according state statistical office for 2015)

	Municipalities	Population Census2002	Population2015 (Estimation from State Statistical officeofthe RepublicofMacedonia)
1	**Aerodrom**	74,486	76,871
2	**Butel**	29,216	38,595
3	**Gazi Baba**	59,292	76,924
4	**Gjorche Petrov**	21,854	42,463
5	**Karposh**	38,948	60,924
6	**KiselaVoda**	104,716	61,101
7	**Saraj**	35,408	40,375
8	**Centar**	82,604	48,479
9	**Chair**	39,179	69,147
10	**ShutoOrizari**	17,357	23,503
11	**Arachinovo**	11,597	13,419
12	**Zelenikovo**	4,077	4,728
13	**Ilinden**	15,894	16,872
14	**Petrovets**	8,255	9,021
15	**Studenichani**	17,246	20,946

16	**Sopishte**	9,522	6,038
17	**Chucher-Sandevo**	8,493	9,873
	Total	**578,144**	**619,279**

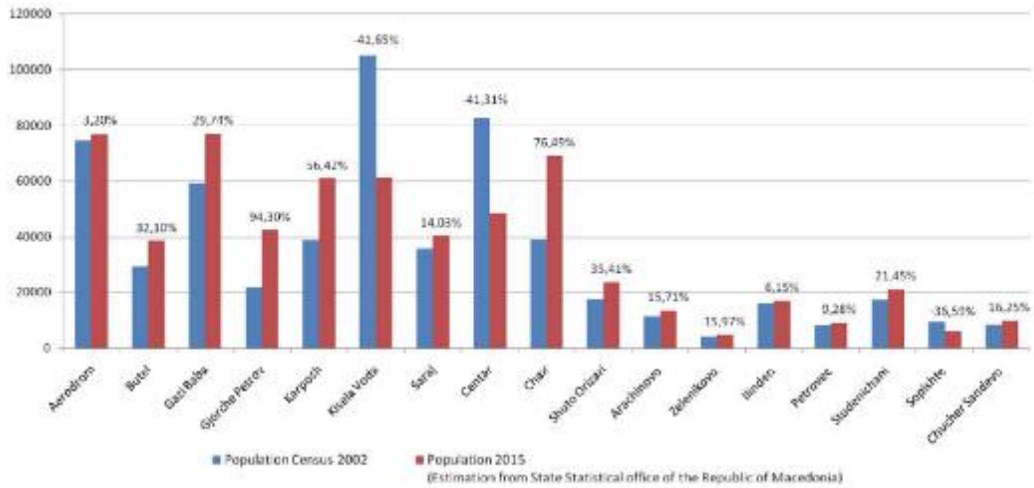


Figure 3-2: Population of Skopje Region Municipalities (Census 2002and estimations according to State Statistical Office for 2015)

As presented in the above chart, the most populated Municipality of the Region in 2002 was Kisela Voda having a population of 104716 habitats (Census 2002) and in 2015 was Gazi Baba having a population of 76924 habitats (est. 30.06.2015) and the least populated Municipality was Zelenikovo having a population of 4077 habitats in 2002 (Census 2002) and 4728 habitats in 2015 (est.30.06.2015).

Table 3-3: Percentage of Rural and Urban Population of Skopje Region Municipalities

Municipalities	2015	
	PercentageofUrban Population	PercentageofRural Population
Aerodrom	96.7%	3.3%
Butel	96.8%	3.2%
Gazi Baba	87.1%	12.9%
Gjorche Petrov	92.2%	7.8%
Karposh	95.4%	4.6%
KiselaVoda	99.2%	0.8%
Saraj	41.5%	58.5%
Centar	100.0%	0.0%
Chair	100.0%	0.0%
Shuto Orizari	97.4%	2.6%
Arachinovo	63.1%	36.9%
Zelenikovo	0.0%	100.0%
Ilinden	53.2%	46.8%
Petrovets	0.0%	100.0%
Studenichani	64.7%	35.3%

Municipalities	2015	
	PercentageofUrban Population	PercentageofRural Population
Sopishte	55.9%	44.1%
Chucher-Sandevo	37.3%	62.7%
Total	85.9%	14.1%

3.2. Seasonal population – current status and future projections

Besides permanent, seasonal population should also be taken under consideration for the purpose of this project. For the calculation of the seasonal population of Skopje Region the following data have been used:

- Data regarding Number of Nights Spent per Municipality of Skopje Region (2014, 2015) have been taken from MAKstat Data Base
- Data regarding Number of Nights Spent in total Skopje Region (2014, 2015) have been taken from MAKstat Data Base

For some Municipalities, the above data are confidential data and were not published according to State Statistical office of RM. Those data are marked with the symbol (-) in the following table.
Furthermore, the assumption that Ilinden and Petrovets Municipalities have zero overnight stays has been made.

According to those Assumptions City of Skopje had 390798 overnight stays in 2014 and 452912 overnight stays in 2015 which corresponds to 16% increase from 2014 to 2015.

Table 3-4: Seasonal population in Skopje Region Municipalities

Municipalities (Skopje Region)	NumberofNightsSpent2014 (Source StateStatistical officeof the RM)	Number of NightsSpent2015 (SourceStateStatistical officeof the RM)
City ofSkopje	390798	452912
Aerodrom	-	-
Butel	-	-
GaziBaba	-	-
Gjorche Petrov	-	-
Karposh	62819	86224
KiselaVoda	8952	6954
Chair	22448	50029
Centar	175256	184420
Shuto Orizari	0	0
Saraj	-	-
Arachinovo	0	0

Municipalities (Skopje Region)	NumberofNightsSpent2014 (Source StateStatistical officeof the RM)	Number of NightsSpent2015 (SourceStateStatistical officeof the RM)
Zelenikovo	0	0
Ilinden	0	0
Petrovets	0	0
Studenichani	0	0
Sopishte	0	0
ChucherSandevo	0	0
Total	**390798**	**452912**

In order to estimate the number of nights spent for the year 2016 an annual growth rate 4,4% for 2015-2021 has been used, according the data from the report "National Tourism Strategy for Macedonia 2009 – 2013". The following table presents the number of nights spent 2016.

Table 3-5:Number of nights spent in Skopje Region municipalities

Municipalities (Skopje Region)	Number of Nights Spent 2016 (estimations take into consideration fromNational Tourism Strategy for Macedonia2009 - 2013)
City of Skopje	472846
Arachinovo	0
Zelenikovo	0
!linden	0
Petrovets	0
Studenichani	0
Sopishte	0
Chucher	0
Total	**472846**

3.3. Economic development aspects

Gross Domestic Product (GDP) and Gross Value added

The following table presents the GDP per capita in denars for years 2010, 2011, 2012 and 2013 for Republic of Macedonia and for Skopje Region.

Table 3-6: GDP per capita 2010-2013

Year	Republicof Macedonia	SkopjeRegion	
2010	212795	308467	144,9%
2011	225493	319717	141,8%
2012	226440	327989	144,8%

2013	243161	348915	143,5%

The GDP in million denars in Republic of Macedonia and Skopje Region is presented in the following table:

Table 3-7:GDP in million MKD 2010-2013

Year	Republicof Macedonia	SkopjeRegion	
2010	437296	185906	42,5%
2011	464187	193717	41,7%
2012	466703	199792	42,8%
2013	501891	213715	42,6%

Labour Market

The following table presents data regarding the activity rate and employment and unemployment rate for Republic of Macedonia and Skopje Region.

Table 3-8: Activity rates of the population aged 15 years and over, annualy

	Year	Republic of Macedonia	Skopje Region
Activity rate	**2013**	**57,2%**	**55,3**
	2014	**57,3%**	**55,3**
	2015	**57%**	**56,3**
Employment rate	**2013**	**40,6%**	**38,0**
	2014	**41,2%**	**39,1**
	2015	**42,1%**	**29,3**
Unemployment rate	**2013**	**29%**	**31,3**
	2014	**28%**	**29,3**
	2015	**26,1%**	**29,0**
Source: State Statistical Office, regional yearbook 2016			

Data on Income & Expenditure per Capita/Household

Latest data from the State Statistical office of the Republic of Macedonia show that the average monthly net wage is 22,356 MKD, for April of 2016. Regarding previous years, data indicate that net wage has been increasing.

Table 3-9: Average monthly net wage and salary growth

	2010	2011	2012	2013	2014	2015
	M1 – M12					
Average monthlynet wage,MKD	20,554	20,848	20,903	21,146	21,394	21,904
Monthly salary growth,y/y,%		1.4%	0.3%	1.2%	1.2%	2.4%

According to data from the State Statistical Office, the average household size for the Skopje region is 3,5 persons per household, slightly lower than the country average which is 3,6 persons per household. The average household size varies from 3 in Karposh and Centar to 5.1 persons per household in Arachinovo.

Table 3-10: Total available assets on average, per household for 2014, MKD

		Decile groups by available assets in RM						
	average	first	third	fourth	fifth	sixth	eighth	tenth
AVAILABLEASSETS	336,289	65,864	163,881	210,946	250,712	303,662	449,582	853,714
Monetary income	320,318	63,534	155,338	195,626	237,658	288,378	431,615	817,852
Income on the basisof regular work	205,646	5,307	54,377	77,902	148,055	188,140	330,959	593,119
Income on the basisof part-time work	11,413	14,293	15,746	14,718	14,870	3,319	16,323	5 647
Income on the basisof pension scheme	68,308	25,936	65,011	73,499	52,516	72,198	62,144	105,423
Otherincomeon thebasis of socialinsurance	5,002	12,151	1,914	6,828	1,895	3,442	4,258	3,550
Income from abroad	8,637	2,038	10,245	10,090	11,626	3,967	5,165	28,097
Net income fromagriculture	16,180	585	2,997	4,604	3,250	11,473	8,894	80,113
Property rentingandselling	883	342	-	313	1,366	944	-	1,538
Donations, gifts andsimilar contributions	560	1,419	33	294	344	508	-	-
Loans (Borrowings)	290	11	299	9	-	-	-	-
Savingsdecrease	3,398	1,452	4,715	7,368	3,737	4,388	3,871	365
Otherincomes	3	100	-	-	-	-	-	-
Source: State Statistical Office								

Table 3-11: Total available assets on average, per household for 2015, MKD

		Decile groups by available assets in RM						
	average	first	third	fourth	fifth	sixth	eighth	Tenth
AVAILABLEASSETS	360,198	78,654	180,524	233,329	282,486	336,780	467,888	895,162
Monetary income	349,430	77,065	172,689	228,908	273,561	326,705	455,419	862,925
Income on the basisof regular work	225,129	11,606	57,195	120,692	167,038	210,664	317,511	650,728
Income on the basisof part-time work	10,762	7,357	21,318	14,956	15,052	7,212	11,900	10,990
Income on the basisof pension scheme	71,774	34,913	63,879	75,097	56,686	76,934	83,245	89,642

Otherincomeon thebasis of socialinsurance	6,413	11,379	7,041	4,145	4,774	5,009	5,580	6,749
Income from abroad	8,848	4,805	7,522	5,662	15,252	7,036	11,500	9,395
Net income fromagriculture	16,648	344	5,357	2,481	5,676	8,932	15,356	80,495
Property rentingandselling	1,947	-	506	1,323	29	566	3,573	7,772
Donations, gifts andsimilar contributions	1,687	2,455	3,778	411	2,323	2,904	1,291	596
Loans (Borrowings)	393	567	935	40	91	280	923	905
Savingsdecrease	5,769	3,638	5,158	4,100	6,271	7,169	4,540	5,652
Otherincomes	60	-	-	-	370	-	-	-
Source:State StatisticalOffice								

3.4. Current affordability

According to the "Application of the Polluter Pays Principle (PPP) in Waste Management Projects" of JASPERS Staff Working Papers, August 2011, it has to be considered that, where household income levels are generally low or household income is unevenly distributed, residential waste tariffs can be temporarily set below full cost recovery levels. In general, for EU funded projects, the common practice seems to be the use of an affordability threshold of around 1.5% of the average household income. Tariffs below full cost recovery levels are maintained only as long as affordability limitations persist.

According to the State Statistical Office, years 2014 and 2015 the average annual income per household in the Republic of Macedonia for is 336,289 MKD and 360,198 MKD respectively and the lowest income is 65,864 MKD 78,654 MKD for years 2014 and 2015 respectively. Data concerning the income in Skopje region is not provided from the State Statistical Office. In order to estimate the average annual income and the lowest annual income for years 2014 and 2015 in this region the proportion of Skopje Region GDP in the Country's GDP was used. The following table provides the average and lowest annual income for Skopje Region for 2014 and 2015.

Table 3-12:Average household income

Skopje Region		
	Average household income	**Lowest household income**
2014.	482,545	94,509
2015.	516,853	112,862

Table 3-13: Affordability of Skopje region for the years 2014 and 2015

	%of Affordabilitylevel			
	Based on annual average incomeof the region		Based on annual lowest income of the region	
	2014	2015	2014	2015
City ofSkopje	56%	49%	287%	223%
Arachinovo	33%	31%	170%	142%

	%of Affordabilitylevel			
	Based on annual average incomeof the region		Based on annual lowest income of the region	
	2014	2015	2014	2015
Chucher -Sandevo	-	27%	-	125%
Ilinden	37%	33%	188%	151%
Petrovets	66%	61%	335%	281%
Sopishte	23%	22%	118%	99%
Studenichani	14%	12%	70%	55%
Zelenikovo	23%	19%	119%	86%

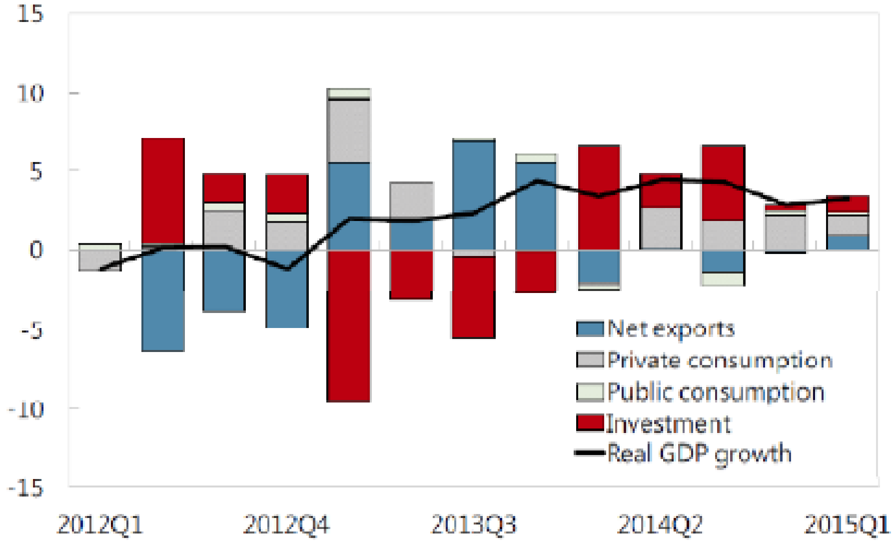
In order to calculate the affordability level, the annual average income as well as the annual lower income for the region (extracted from the State Statistical Office) were taken into consideration. For 2014, the affordability level 1.5 % of the annual average income was calculated at 7,238 and for 2015 at 7,753.

For 2014, the affordability level 1.5 % of the annual lowest income was calculated at 1,418 and for 2015 at 1,693. The following table presents the percentage of affordability level in Skopje Region based on average income and based on lower income, for the years 2014 and 2015.

According to the above calculations and considering the average annual income for the municipalities that provided relevant data, the waste fees per household were affordable for both years 2014 and 2015. Considering the lowest annual income, for the municipalities that provided relevant data, the waste fees per household were affordable for both years 2014 and 2015 only for Studenichani municipality, and for the year 2015, for the municipalities Sopishte and Zelenikovo.

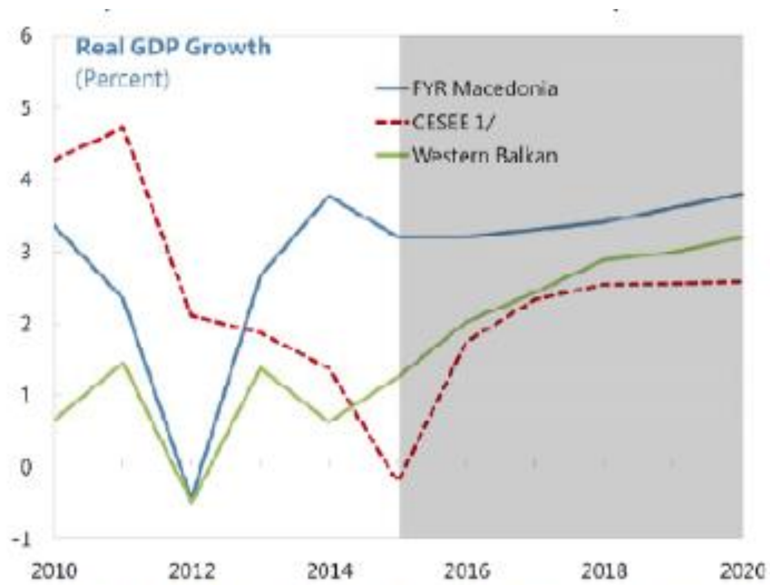
3.5 Future economic development and affordability

Real GDP growth accelerated in 2014 to 3.8% and strong growth continued in 2015Q1. Double-digit growthin investment, and strong private consumption supported by credit growth and improved labor marketconditions, boosted output. Favorable developments in exports, domestic demand and credit continuedthrough the first quarter, but there are some incipient signs of slowdown since May. GDP growth wasexpected to remain broad-based but moderate to 3.2% in 2015, before gradually improving over themedium term. Some private investment plans, both domestic and foreign, are reportedly on hold until newelections, while private consumption is being affected by negative confidence effects. A projection of theReal GDP Growth is presented at Figure 3-8, for the years until 2020; growth seems to continue in theforthcoming years, until 2020.



Source: IMF Country Report No. 15/242, International Monetary Fund

Figure 3-3: Republic of Macedonia: Contribution to Real GDP Growth (Percent)



Source: IMF Country Report No. 15/242, International Monetary Fund

Figure 3-4: Republic of Macedonia: Real Sector Developments, 2010-2015

4. WASTE CONTENT AND FUTURE GENERATION FORECAST

4.1 Morphological composition of the mixed municipal waste

For purpose of sampling and analysis of morphological composition of waste on the municipality level, it is necessary to bring waste samples of approximately 300 kg in weight to the site for analysis. Local representatives in cooperation with technical supervisors determined that samples will be taken from two types of urban zone (individual and collective housing) as well as rural part of the regions:
1) urban zone I –collective housing and commercial areas (settlements with blocks of residential buildings);
2) urban zone II – individual houses (settlements with houses that own yard /garden, situated in the urban zone), and
3) rural zones – within the municipalities (settlements with houses that own yard / garden, situated in a rural zone of the municipality)
The following Figure, illustrates the average morphological waste composition for each Municipality of Skopje region.

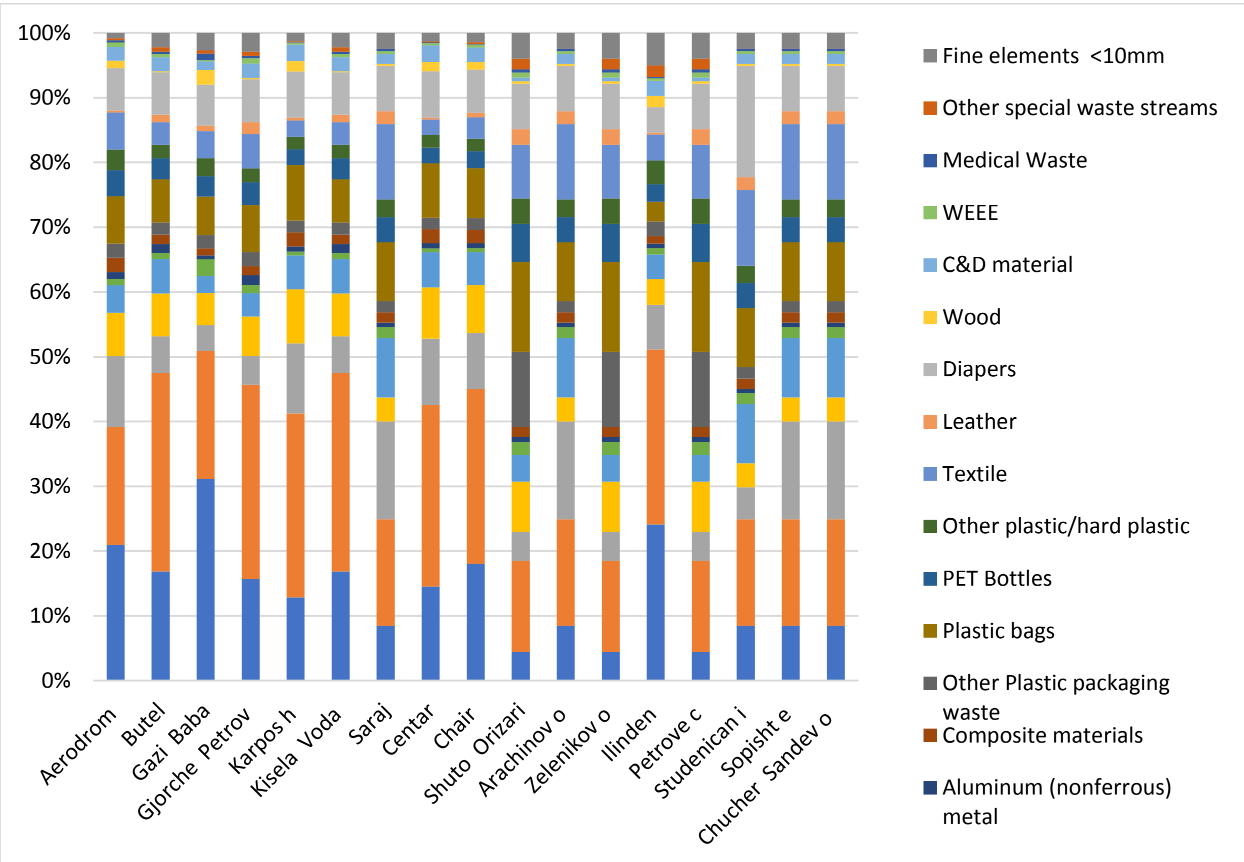


Figure 4-1: Average waste composition for each Municipality of Skopje region

When comparing the composition of waste in municipalities in Skopje Region, there is a difference in terms of the share of different waste categories, especially when it comes to organic waste fractions, i.e. "other biodegradable waste" and "garden waste", but also other fractions as (such as textile and fine fraction). The highest amount of garden waste was noted in Gazi Baba (31,17%), while high amounts were also noted in Ilinden (24,08%), Aerodrom (20,94%) and Chair (18,03%). In the other municipalities, this fraction's share is in general lower, i.e. 14,51% for Centar and 8,43% in case of Arachinovo.

The highest share of other biodegradable waste was recorded in Kisela Voda and Butel (30,66% in each), and the lowest in Shuto Orizari, Zelenikovo and Petrovets (14,04% in each). The share of paper is mostly in range from 4,0% to 15,0%. In terms of cardboard waste fraction the highest amount is for Karposh (8,38%), and the lowest in case of the municipalities Saraj, Arachinovo, Studenichani, Sopishte, Chucher Sandevo (3,69% for each). Glass has different shares in waste composition depending on municipality, from around 2,6% in Gazi Baba to 9,2% in the municipalities of Saraj, Arachinovo, Studenichani, Sopishte and Chucher Sandevo.
Metal with two subcategories generally did not have a significant share in waste composition of observed municipalities. Other than Gazi Baba, where 2,57% of ferrous metal was recorded, this category is generally not higher than 2,0%. Aluminum (non-ferrous metals) share is 1,49% in municipality Gjorche Petrov, while Gazi Baba (0,59%) has the lowest proportion. Waste in composite materials form did not have significant share in overall waste composition, and its range is from 1,08% to 2,21% for all municipalities.

Plastic packaging waste, generally has a share about 2,0% for the observed municipalities, except in the case of Shuto Orizari, Zelenikovo and Petrovets, where the portion of this category is 11,65%. Plastic bags is the most dominant light fraction of waste for the majority of municipalities. The highest mass share of plastic bags was recorded in Shuto Orizari, Zelenikovo and Petrovets (13,86% in each), while the lowest amount was found in Ilinden (3,06%). The highest share of PET bottles, as a fraction with the highest recyclable potential, was recorded in Shuto Orizari, Zelenikovo and Petrovets with 5,90% for each, while for the rest of municipalities amounts were in range from 2,4% to 4,0%. Other plastic waste range is from 1,9% to 3,9% for all municipalities.

Differing from the aforementioned fractions, textile has greater variations depending on the observed municipality. In the municipality of Centar it takes only 2,33% in waste composition, while in Saraj, Arachinovo, Studenichani, Sopishte, Chucher Sandevo it reaches 11,69%. In waste composition, leather is one of the lowest represented fractions for all the municipalities. Higher value was noted only in Shuto Orizari, Zelenikovo and Petrovets (2,42% in each).Diapers are represented in the overall waste composition in a range from around 6,0% to 7,0%. Wood fraction definitely represents one of the waste categories with the lowest shares in overall composition for all observed municipalities, ranging from 0,12% to 2,31%.Construction and demolition material fraction has a relatively narrow range of values, as it deviates from 0,55% in case of Shuto Orizari, Zelenikovo and Petrovets to 2,55% in case of Centar. WEEE, just like wood fraction, is poorly represented in waste composition of Skopje municipalities and it is in the range from 0,19% to 0,83%. Hazardous materials were noticeable only for the municipality of Gazi Baba with a share of 1.0%, while for all other municipalities it is below 0,5%.

For fine elements, i.e. soil, ash and other fractions smaller than 10mm, there are also variations in composition depending on the municipality: in Ilinden the share of fine elements was 5,04%, in Shuto Orizari, Zelenikovo and Petrovets it was 3,96% (for each), while in Aerodrom only 0,83%.

In order to calculate the average morphological waste composition of Skopje region, the share of population of each Municipality has been used. The average waste composition in the region has been calculated, and presented in the following table.

Table 4-1: Average morphological waste composition for Skopje Region

Fraction	Totalpresentence%
Gardenwaste	14.08%
Otherbiodegradable waste	28.19%
Paper	7.81%
Cardboard	5.84%
Glass	4.56%
Metals (ferrous)	1.06%
Aluminum(non-ferrous)	0.73%
Composite Materials	1.59%
Plasticpackagingwaste	4.32%
Plasticbags	7.81%
PETbottles	3.48%
Otherplastic	2.26%
Textile	5.45%
Leather	1.00%
Diapers	6.10%
Wood	0.64%
Construction and demolitionmaterial	1.72%
WEEE	0.41%
Hazardous materials (Medical waste)	0.24%
Otherspecialwaste streams (Elastic-tyres etc)	0.51%
Fine fraction(<10mm)	2.22%
Total	**100.00%**

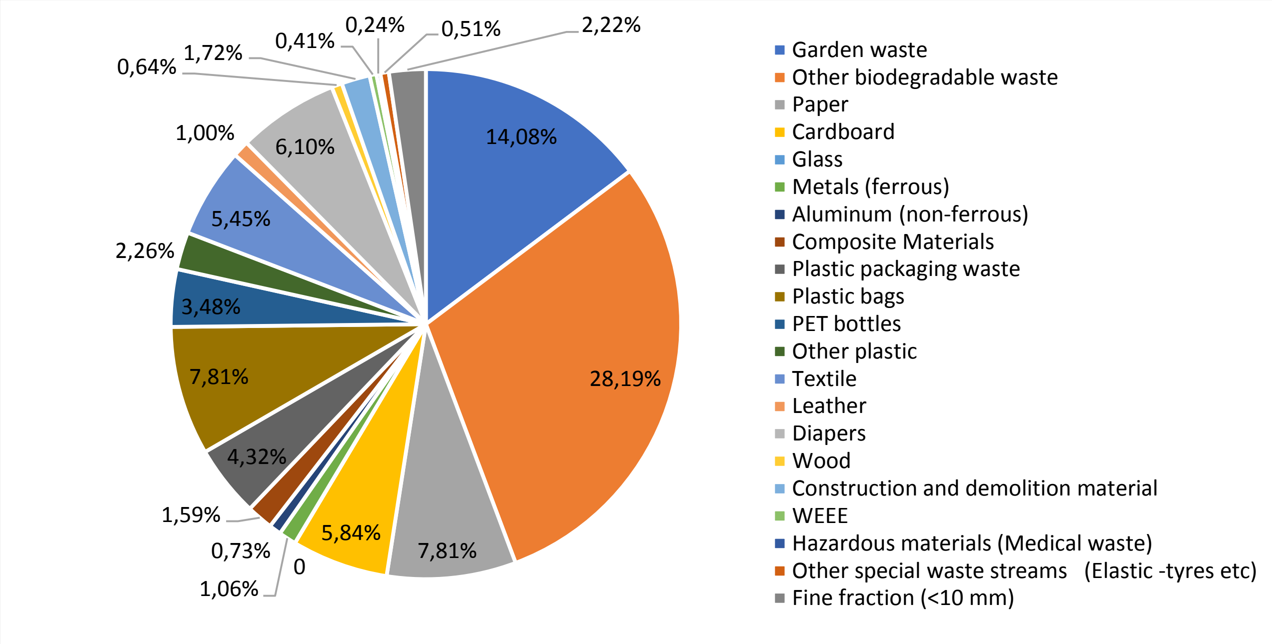


Figure 4-2: Average morphological waste composition for Skopje Region

4.2 Future waste generation forecast

The projection is an essential element in the planning process. Based on the municipal waste generation projection, the targets set at regional level are quantified, as well as the capacities of the waste management facilities to be installed, are determined.In order to forecast future quantities of municipal waste in Skopje Region, permanent and seasonal population growth were observed. The following Table 4-2, present the forecast for the permanent population of the Region.

Table4-2:PermanentpopulationprojectionforSkopjeRegion

Skopje Region	2016	2021	2026	2031	2036	2041	2046
CityofSkopje	539,398	544,900	552,173	559,717	564,806	566,667	565,792
Arachinovo	13,420	13,419	13,368	13,253	13,070	12,833	12,554
Chucher -Sandevo	9,858	9,766	9,574	9,289	8,949	8,586	8,211
Ilinden	16,864	16,802	16,637	16,362	15,998	15,577	15,117
Petrovets	8,987	8,781	8,402	7,876	7,294	6,715	6,148
Sopishte	6,036	6,020	5,971	5,885	5,768	5,629	5,475
Studenichani	20,950	20,960	20,900	20,747	20,487	20,141	19,729

Zelenikovo	4,710	4,602	4,404	4,128	3,823	3,519	3,222
PermanentPopulation	620,223	625,251	631,429	637,256	640,194	639,667	636,248

The population of the waste management region as a whole, has projected to be increased between 2016 – 2046 by 2.58%. As shown in the table above, and the, increase of population in region is mainly due projected increase of population in the City of Skopje, while there are significant decreases projections in the populations of all the other municipalities in the region.In order to calculate the forecasting of the seasonal population of Skopje Region, the indicators from the "National Tourism Strategy in Macedonia 2009-2013 (Realistic Scenario)", were taken into consideration (i.e. the average annual rate of change was calculated to be 4.40% from 2015 to 2021, 5.92% from 2021 to 2030 and constant from 2031 to 2046).

4.2.1 Waste generation rate growth for permanent population

The following four proposed scenarios for the projection of the Waste Generation Rate (WGR) of the permanent population have been examined, based on the National Waste Management Plan 2009-2015:

- Scenario 1: Zero growth - no growth in per capita generation, waste generation grows proportionally to population
- Scenario 2: Low growth - in addition to population growth, per capita generation linked to 50% of growth in GDP followed by 2% between years 2021-2030
- Scenario 3: Medium growth - as Scenario 2 but assume GDP growth of 5% for 10 years after EU membership
- Scenario 4: High growth - as Scenario 3 but 100% linkage to GDP growth The scenarios have been quantified in regional level and will be applied per municipality of Skopje Region.

For the projection of the country's GDP, data from the IMF Country Report No. 15/242 were used. Specifically, the projection of the real GDP of the Beneficiary country is shown at the table below.

Table4-3:GDPgrowthaccordingtotheIMFprojection

Year	2017	2018	2019	2020
RealGDPinBeneficiary country	3,3 %	3,4 %	3,6 %	3,8 %

In the table that follows, the % change of Waste Generation rate (kg/ca/year) for each of the four (4) proposed scenarios is depicted.

Table4-4:Changeinpercapitawastegenerationrate(%)for different Scenarios

Year %Changein Waste Generationrate (kg/ca/year)	2017	2018	2019	2020	2021- 2030	2031- 2046
Scenario 1	No growthin per capitageneration					
Scenario 2	1,56%	1,52%	2,94%	2,78%	0,20%per year	-
Scenario 3	1,56%	1,52%	2,94%	2,78%	0,49%per year	-

Scenario 4	3,13%	3,03%	5,88%	5,56%	0,49%per year	-

According to the 1st Scenario, the % Change in Waste Generation rate is zero, i.e. there is no growth in per capita generation, and waste generation grows proportionally to the population. In the 2nd Scenario, the % Change in Waste Generation rate is low, i.e. in addition to population growth; the ‘per capita’ generation is linked to 50% of growth in GDP (projected at 3% p.a.), while in the 3rd Scenario, the % Change in Waste Generation rate is medium, where GDP growth of 5% for 10 years after EU membership (projected to be in 2012) was considered. Finally, within 4th Scenario, the % Change in Waste Generation rate is high, i.e. as in scenario 3, but the linkage to GDP growth is 100%.

4.2.2 Waste generation rate growth for seasonal population

The waste which produced from seasonal population have been estimated taking into consideration the assumption that an average tourist in Europe generates approximately 1,2 kg of waste per bed night (CREM, 2000). Taking into account the overnights’ projection in Skopje region, the Waste Generation Rate of the seasonal population was considered stable and equal to 438 kg/ca/year for all years within the examined period of time (2016-2046), and for all municipalities within Skopje region.

Selected model of future municipal waste generation in Skopje Region

Based on the previous calculations, a Forecast of Waste production for the years 2016-2046 was made, according to Scenario 2. The results are presented in the following table.

Table4-5:ForecastofWasteProductionofSkopjeregion(t)forScenario 2

Year	2016	2021	2026	2031	2036	2041	2046	% Change (2016-2046)
City ofSkopje	146,590	162,017	166,173	170,191	171,917	172,654	172,551	**+ 17,7%**
Arachinovo	3,395	3,717	3,751	3,762	3,725	3,672	3,606	**+ 6,2%**
Zelenikovo	1,821	1,976	1,962	1,928	1,866	1,799	1,729	**- 5,1%**
Ilinden	2,734	2,983	2,993	2,980	2,927	2,863	2,790	**+ 2,0%**
Petrovets	2,270	2,424	2,343	2,214	2,050	1,887	1,728	**- 23,9%**
Sopishte	1,198	1,308	1,315	1,312	1,291	1,266	1,236	**+ 3,2%**
Studenichani	3,600	3,943	3,982	4,000	3,965	3,913	3,847	**+ 6,9%**
ChucherSandevo	1,274	1,360	1,314	1,242	1,150	1,059	969	**- 23,9%**
TotalProduced Waste (t)in Skopje Region	162,883	179,729	183,834	187,627	188,892	189,113	188,456	**+ 15,7%**

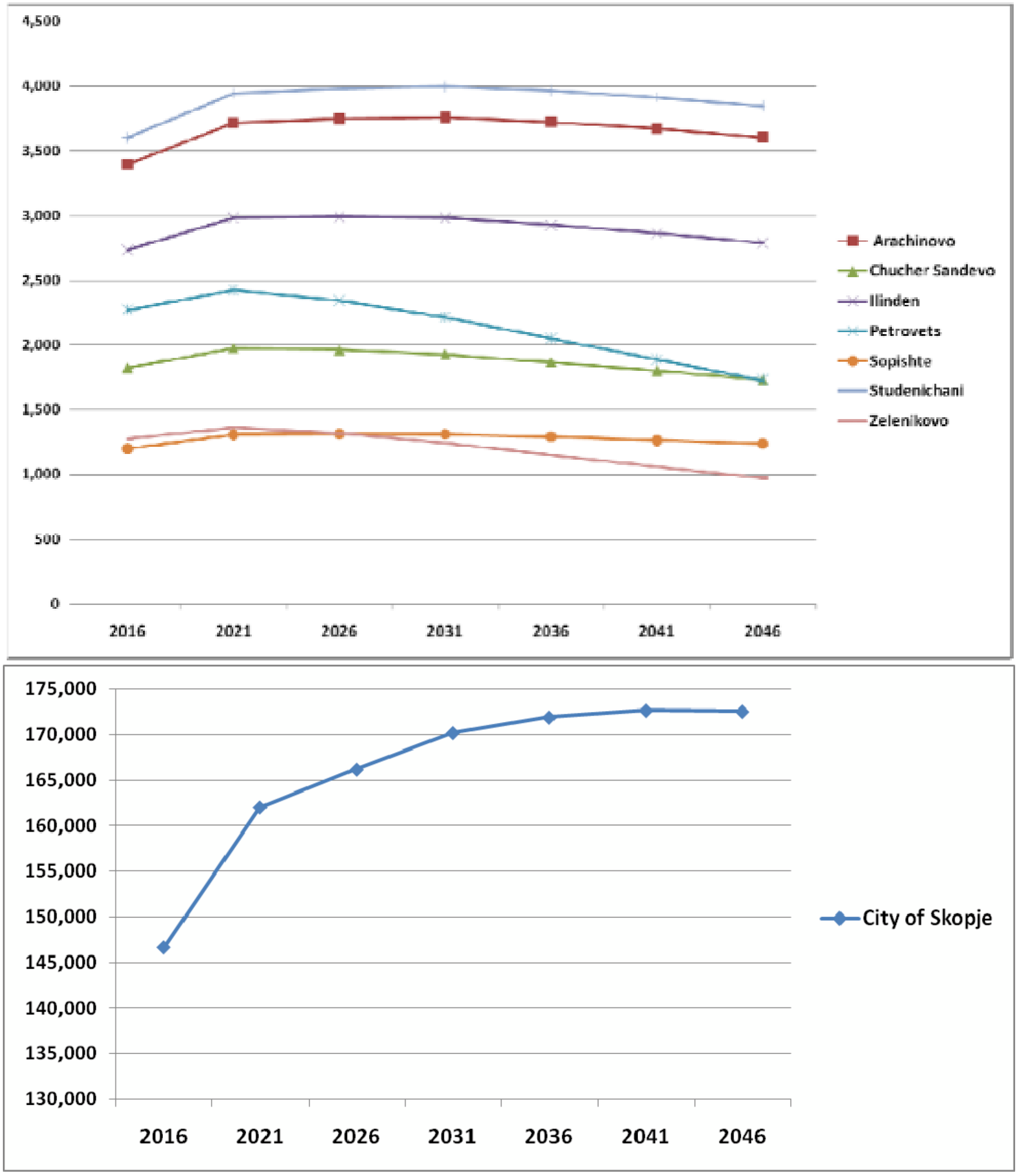


Figure4-3:Forecastof WasteProductionofSkopjeregion(t)forScenario 2

5. LEGAL AND REGULATORY FRAMEWORK

5.1 EU waste management policy and Directives

The EU's Sixth Environment Action Programme identified waste prevention and management as one of its top priorities. Its primary objective was to ensure that economic growth does not lead to more and more waste. This led to the development of a long-term strategy on waste. The 2005 Thematic Strategy on Waste Prevention and Recycling resulted in the revision of the Waste Framework Directive, the cornerstone of EU waste policy. The revision brought a modernized approach to waste management, marking a shift away from thinking about waste as an unwanted burden to seeing it as a valued resource. The Directive focused on waste prevention and puts in place new targets, which will help the EU move towards its goal of becoming a recycling society. The Directive introduced a five-step waste hierarchy where prevention is the best option, followed by re-use, recycling and other forms of recovery, with disposal such as landfill as the last resort. The revised Waste Framework Directive gives greater emphasis to the priority position accorded to waste prevention.

Europe, aims to ensure that by 2020 waste is managed as a resource; waste generated per capita is in decline; re-use and recycling of waste are economically attractive options for public and private actors; more materials are recycled according to high quality standards; energy recovery is limited to non-recyclable materials; landfilling is virtually eliminated; and illegal shipments are eradicated. Collection, recycling and recovery targets to be reached between 2011 and 2020 have been introduced by binding legislation for various waste streams. Directive 2006/66/EC addresses batteries, Directive 2008/98/EC addresses non-hazardous construction and demolition waste, as well as paper, plastic, glass and metal from households, and Directive 2000/53/EC addresses end-of-life vehicles. Similar targets were previously established for the period 2001–2008 for other waste streams. For example Directive 2002/96/EC addresses waste electrical and electronic equipment and was followed recently by Directive 2012/19/EU. Similarly, Directive 94/62/EC, as amended by Directive 2004/12/EC, addresses packaging waste. Directive 1999/31/EC, known as the Landfill Directive, sets other compulsory targets concerning biodegradable municipal waste (BMW). It provides that Member States shall ensure, through national strategies, that the disposal of BMW is progressively reduced to 35 % of the total amount (by weight) of BMW produced in 1995 by 2016, with a preliminary target of 75 % by 2006 and an intermediate target of 50 % by 2009.

Circular Economy Strategy

The European Commission adopted an ambitious Circular Economy Package, which includes revised legislative proposals on waste to stimulate Europe's transition towards a circular economy which will boost global competitiveness, foster sustainable economic growth and generate new jobs. The Circular Economy Package consists of an EU Action Plan for the Circular Economy that establishes a concrete and ambitious programme of action, with measures covering the whole cycle: from production and consumption to waste management and the market for secondary raw materials.

The annex to the action plan sets out the timeline when the actions will be completed. The proposed actions will contribute to "closing the loop" of product lifecycles through greater recycling and re-use, and bring benefits for both the environment and the economy.

Targets:

- EU target for recycling 65% of municipal waste by 2030;
- EU target for recycling 75% of packaging waste by 2030;
- material specific targets for different packaging materials
- a binding landfill reduction target of 10% by 2030 Measurements
- Simplification and harmonization of definitions and calculation
- General requirements for the operation of Extended Producer responsibility (EPR) schemes meaning a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle, aimed at improving their performance and transparency, including direct financial incentives for greener product design.

The EU recognises seven over-arching principles for waste management, which should be considered in the waste management plan:

Waste Management Hierarchy. Waste management strategies must aim primarily to prevent the generation of waste and to reduce its harmfulness. Where this is not possible, waste materials should be reused, recycled or recovered, or used as a source of energy. As a final resort, waste should be disposed of safely (e.g. by incineration or in landfill sites);

Self-Sufficiency at Community and, if possible, at Member State level. Member States need to establish, in co-operation with other Member States an integrated and adequate network of waste disposal facilities;

Best Available Technique Not Entailing Excessive Cost (BATNEEC). Emissions from installations to the environment should be reduced as much as possible and in the most economically efficient way;

Proximity. Wastes should be disposed of as close to the source as possible;

Precautionary Principle. The lack of full scientific certainty should not be used as an excuse for failing to act. Where there is a credible risk to the environment or human health of acting or not acting with regard to waste, a cost-effective response to the risk identified should be pursued;

Producer Responsibility. Economic operators, and particularly manufacturers of products, have to be involved in the objective to close the life cycle of substances, components and products from their production throughout their useful life until they become a waste;

Polluter pays. Those responsible for generating or for the generation of waste, and consequent adverse effects on the environment, should be required to pay the costs of avoiding or alleviating those adverse consequences. A clear example can be seen in the EU Directive 99/31/EC on landfill of waste, Article 10.

Most of the above principles are incorporated in the Macedonian Law on Waste Management, for example Article 7 on priorities in waste management, Article 9 on the precautionary principle, Article 10 on the proximity principle and Article 12 on the polluter-pays. Therefore, the Law incorporates the basic principles of waste management. Waste management, as a public service, is based on the principle of service universality (non-discrimination, sustainability, quality and efficiency, transparency, affordable price and full coverage of the territory).

5.2 National political and institutional framework

On a national level, the general waste management policy was established in the Law on Environment (“Official Gazette” No.53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/2013, 44/2015), in the National Environmental Programmes (NEAP 1996/2007) and particularly in the Law on Waste Management (“Official Gazette” No.68/04, 71/04, 107/07, 102/08, 134/08, 124/10, 08/11, 51/11 and 123/12, 147/13 and 163/13). The Law on Waste Management has important links to other Laws related to tasks and responsibilities regarding administrative, organizational and operational issues in waste management, in particular to the Law on the Environment, which includes basic provisions on environmental permitting, EIA procedure and greenhouse gas emissions.

The issue related to the management of sludge from urban wastewater treatment is regulated in the Law on Water. Moreover, separate laws have been adopted for packaging and packaging waste, WEEE and batteries and accumulators, namely:

- The Law on Packaging and Packaging Waste (2009) (LoPPW) (“Official Gazette” No. 161/09, 17/11, 47/11, 136/11, 6/12 and 163/13),
- The Law on Batteries and Accumulators and Waste Batteries and Accumulators (2010) (LoBAWBA) (“Official Gazette” No. 140/10, 47/11, 148/11, 39/12 and 163/13)
- The Law on Electric and Electronic Equipment and Waste Electric and Electronic Equipment (2012) (LoEEEWEEE) (“Official Gazette” No. 6/12 and 163/13) Secondary legislation based on these laws has been adopted as well

The responsible authorities of the Republic of Macedonia, the Municipalities and the City of Skopje, as well as legal and physical persons dealing with waste management shall adopt and implement strategic, planning and programme documents regarding the waste management in order to:

- Protect the environment and human life and health;
- Achieve the objectives and guidelines laid down in the National Environmental Action Plan;

- Implement the general principles and guidelines regarding the waste management;
- Establish an integrated national network of installations and plants for waste processing and disposal;
- Fulfill the obligations with regard to the waste management undertaken by the Republic of Macedonia on an international level; Within the procedure for adoption of strategies, plans and programmes provided for in the LoWM, strategic environmental assessment shall be undertaken in accordance with the Law on Environment. Article 16, Strategy on Waste Management The Government of the Republic of Macedonia shall, upon a proposal of the body of the public administration responsible for the affairs of the environment, adopt a Strategy on Waste Management.

The current national WM legislation provides for a comprehensive set of planning documents at all levels. Central level: It is obligatory to elaborate and implement a National WM Strategy and a National WM Plan, as well as National programmes for special waste streams such as Packaging waste, Batteries and Accumulators waste. For implementing the National plan there shall be an annual National programme. The responsible authority is the MoEPP.

Regional level: The recent amendments to the LoWM established that Regional Waste Management Plans could be adopted and implemented jointly for several municipalities for establishing a regional integrated waste management system. The RWMPs have to be approved by MoEPP and adopted by all of the municipal councils of the municipalities involved. The Regional Waste Management Boards established by the municipalities based on the voluntary cooperation shall be responsible for the adoption and implementation of the regional plans.

Municipal level: The municipalities are obliged to elaborate and implement Municipal Waste Management Plans. The MWMP has to be adopted by the municipal council of the municipality involved and approved by MoEPP. For implementing the Municipal plan there shall be an annual municipal programme.

The waste producers (industry, service providers and waste facility operators) are obliged to elaborate and implement waste management programmes for a period of three years. These programmes have to be submitted to the relevant municipality and MoEPP. The Waste Management Programmes in the facilities of health and veterinary protection have to be approved by the MoH.

5.3 Local spatial policy

The Spatial Plan of the Republic of Macedonia (2004) shows a list of protected areas along with data on the protection status and the Municipality they belong to. According to the Law on Protection of Nature (Official Gazette of the Republic of Macedonia No. 67/2004), the protected areas that were proclaimed as such before the entry into force of this law, will undergo revalorization and proclaimed as protected areas within three years from the day of entry into force of this Law.

The revalorization period was extended to six years and is still not finished. During the transitional period, the protected areas that initially had such status were re-proclaimed as protected areas in accordance with the Law on Protection of Nature. These areas are also protected by Law and by decisions adopted by the City of Skopje. The 2004 Spatial Plan incorporates emphasized strategic development connotation and defines and establishes the basis and at the same time feasible goals and directions for development, especially with regard to the necessary qualitative and quantitative structural changes and the relevant and adaptable spatial planning solutions and options.

This document constitutes a foundation for the organization, development, use and protection of space in the country, covering a 20-year period. The Study on the Environment and Nature Protection, carried out within the framework of the Plan, specifies the goals and planning guidelines for environment protection, as part of the overall activities in the field of spatial planning. One of the main objectives of the Spatial Plan is about saving, rational use and protection of the natural resources, especially those that are scarce and strategically relevant for development and quality of life in Macedonia.

In addition to the main objective (introduction of integrated and sustainable waste management system), other objectives of the Spatial Plan incorporated in the RWMP are:

- Harmonization of the national and EU requirements; - Increased number of new jobs; - Reuse of the waste, recycling and other type of
- Development of rural areas as multi-functional areas and improvement of the economic power of the rural households.
- Waste control through construction of landfills featuring integrated and sustainable management system.
- Introduction of best new available techniques for recovery;
- Introduction of system for collection, selection, pre-treatment, registration and declaration of the composition, quantities, transport, manipulation and disposal at one (maximum two) sanitary landfill for inert waste and partially damaged waste.
- waste management in order to reduce the negative impact on the media and the environmental areas.
- Remediation of the landfills for municipal and solid waste, including the dumpsites.
- Identification of optimal solutions for regional disposal according to the type and quantity of generated waste.

5.4 The implications of the legal and policy issues on the project

Pursuant to Article 18-a, Paragraph 1 of the Law on Waste Management ("Official Gazette of the Republic of Macedonia" No. 68/04, 71/04, 107/07, 102/08, 134/08, 09/11, 123/12, 147/13, 163/13, 156/15 and 63/16), the Councils of the municipalities, the Council of the City of Skopje upon a proposal of the Inter-Municipal Waste Management Boards adopt Regional Waste Management Plans, for the regions determined by the National Waste Management Plan of the Republic of Macedonia.

The Regional Waste Management Plans shall regulate and harmonize joint waste management objectives at regional level, according to the Waste Management Strategy (2008-2020) and the National Waste Management Plan (2009-2015).

In accordance with the Law on Waste Management, the Regional Waste Management Plans are adopted for a period of 10 years. Pursuant to Article 18-a, Paragraph 4 of the Law, the Inter-Municipal Waste Management Board may propose amendments to the regional plan every two years.

The Regional Plan is instrument for implementation of the objectives set in the National Plan i.e. the National Waste Management Plan of the Republic of Macedonia, on regional level. For this purpose, it is necessary to harmonize the objectives of the Plan with those set in the higher strategic waste management documents. In addition, the objectives of the Plan also have to be harmonized with all other relevant objectives set in other higher relevant strategic documents. The main objective of the Plan is reduction of the negative impacts on the environment and human health when it comes to waste management. The Plan will be the basis for the integrated waste management system in a manner that will control the various waste streams that will be created and will also provide directions for managing the waste.

The Table below shows the correlation between the objectives included in the national strategic documents on waste management and the objectives set in the RWMP, and the manner in which they will be achieved.

The summary of key EU and national policy implications are:

- To ensure at least 95% coverage with organized waste collection services, with complete coverage being the ultimate goal;
- Increased separation of materials, particularly hazardous waste from mixed municipal waste;
- Increased recovery of materials, notably preparing for re-use or recycling 50% of paper, glass, metal and plastic;
- Increased recovery of energy;
- Ensure safe disposal of residual waste;
- Separate collection of other fractions i.e. other separate waste streams (tires), WEEE and construction and demolition waste;
- Home composting campaigns;
- Separate collections of garden waste that will be diverted towards the process of composting in furrows thus producing high quality compost;
- Reduce waste to landfill in general and specifically reduce the biodegradable fraction to landfill.

The assessment is tasked with identifying the optimum means by which these can be achieved, while maintaining cost recovery tariffs at an affordable level for the population.

In considering the available options, it is important to recognize that:

- The investments required to achieve compliance are potentially large and have been reported for new Member States as being in excess of €100 per capita;
- Full cost recovery needs to be achieved in accordance with the polluter pays principle: bearing in mind that solid waste management entails relatively high operational costs, will entail a substantial increase in tariffs, even if some of the infrastructure investment is grant funded;

Therefore, the assignment has attempted to identify:

- Potential long-term options that can be implemented to achieve full compliance;
- Interim short to medium-term steps that can be taken without breaching the affordability constraint.

5.5 Available sources of financing

According to the National Waste Management Plan 2009-2015 the main possible sources of financing investments for the implementation of the EU waste legislation, for the execution of the variety of organizational and public relations tasks, and for elaboration of the necessary technical, spatial and investment documentation and environmental studies and capital investments, are:

- waste producers (measures they take themselves);
- public sources consisting of:
    - charges paid by waste producers to waste management service providers,
    - fees for licenses and other services,
    - State or municipal budgets, and
    - investment funds (established on the regional/inter-municipality level);
- private capital (through direct private investments, through the Public Private Partnership arrangements, CO_2 credit lines), and
- International funds and financial institutions providing grants (IPA fund, ERDF, international donors) and loans (different IFI, bilateral financing institutions, commercial bank, bonds issued by the central or local government authorities.

By means of the earmarked addition to the selling price of waste-generating products levied by the producer or importer, the producers or importers may fund a system organized by themselves to collect, recover and dispose of waste (end-of-life products) according the "producer’s and or importer’s responsibility principle". There is also another option available: earmarked taxes levied by the state or other public authority on waste-generating products (end-of-life products) are collecting in the environmental fund (in principle in the State budget); these taxes are used for organization and execution of collection, recovery and disposal of waste residues in the organization form of the joint public services.

Such a system also represents one of the economical/financial instruments. Some of these main, various sources are considered below:

- ***Waste producers (measures they take themselves)***
  For example, producers of some high volume hazardous wastes will be required either to take measures to reduce the volume of hazardous waste being produced or to store or dispose of that waste in a manner which meets EU standards. This will be done at their own expense.

- ***Charges paid by waste producers to waste management service providers***
  These will mainly be charges for waste collection and disposal. Waste producers are already paying such charges to local authorities and to transport contractors who transport their waste, but these charges are likely to rise to reflect the costs of complying with EU legislation.

- ***Fees for licenses and other services***
  The costs of a competent authority for issuing and maintaining a waste management license or for carrying out an inspection could be met by levying a fee for that activity.

- ***State or municipal budgets***
  This may be either part of the regular budget or a special allocation earmarked to deal with a one-off or special situation. Earmarked taxes as well as surcharges on improper waste management practices may also become a significant resource of regional funds established on inter-municipality level and intended for regional investments in the MSWM infrastructure facilities. Establishment of the investment funds from earmarked sources on the State and regional level is very important for a country developing a new waste management system almost from the very beginning. There are a lot of tasks on the national and local level with regard to elaboration of the variety of documentation which need their own financial sources; the majority of international investment institutions also require a determined part of the co-investment.

- ***Grants from other international donors***
  A variety of bilateral development cooperation organizations provide grants to middle income countries preparing for accession to the EU such as Macedonia. These include US-AID, GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit), Danida (Danish International Development Aid), SIDA (Swedish International Development Aid), DfID (Department for International Development of UK), SDC (Swiss Agency for Development and Cooperation), ADA (Austrian Development Agency), JICA.

- ***Loans from international funding institutions***
  The international funding institutions (IFIs) are development banks such as the World Bank, the

European Bank for Reconstruction and Development (EBRD) and the European Investment Bank (EIB), which offer loans at a relatively low rate of interest for investments (amongst others) intended to establish or improve environmental facilities or infrastructure. In general, applications for financing to an IFI will need to have the official approval and a supporting guarantee from the government of the beneficiary country.

An exception to this general rule is the EBRD, which may require a sovereign guarantee. However, the interest rates charged by the EBRD tend to be higher than those typically offered by other international (or bilateral) financing institutions (for example LIBOR + 2 to 4%, say 6 to 8% at the time of writing). The World Bank will only lend to a government body but the EBRD and the EIB will also lend to private companies. Most of the international financing institutions will only lend to companies or to corporate entities having clearly defined objectives, management and decision-making structure, which are operated along commercial lines. Also, some institutions have a minimum size of loan. For example, the EBRD will only directly finance loans of 5 million US or greater. These constraints tend to limit the scope for IFI participation in financing capital investments to projects of a fairly substantial size. In addition, significant resources and time are usually needed to develop and negotiate an IFI loan.

The World Bank recently finalized its Country Partnership Strategy 2007-2010 for the beneficiary country. The total funding for 2007-2010 shall be 230 million US $. Of this, perhaps 10% will go to municipal development. The World Bank at present is not enthusiastic about investing in wastewater treatment in the beneficiary country (doubts about sustainability due to high operating costs), but thinks the time is ripe for the development of modern waste management facilities.

– ***Loans from commercial banks***

  Local authorities may be able to obtain loans from commercial banks, but the terms are likely to be much less favorable than from international and bilateral funding institutions. The banking sector in the Republic of Macedonia is presently hampered by a relatively uncompetitive banking climate low banking efficiency and difficulties in assessing the credit risks of potential borrowers.

- Bonds issued by local government authorities

  Most local authorities, with the possible exception of the City of Skopje, are probably not yet at a stage where they can envisage issuing bonds as a means of raising finance. This is because of their small size, lack of an independent audit of their accounts, low quality of financial data, the need for obtaining a credit rating from organizations such as Standard and Poor, Moody's, etc.

- Private capital

  The private sector could play a role in financing the development of the waste management infrastructure in the country. There are many different arrangements by which the private sector could participate, for example private contractors could operate a sanitary landfill as a concession or the landfill might be the subject of a BOT (Build - Operate - Transfer) contract. Such constructions will require a number of developments before they can be envisaged in the beneficiary, including reform of accounting in municipalities and communal enterprises, clear evidence that the state is willing to enforce the new laws and that municipalities are willing to allow the real waste management costs to be charged to waste producers and the emergence of credible operators of the new facilities.

- Public-private partnership

Private sector participation can satisfy numerous aims: investment capital provision, reduction of subvention needs, improvement of management efficiency, improvement of technical and managerial capacities of a public utility company, etc.

Public-private partnership refers to a partnership between public and private sectors (PPP) in activities connected with public sector and/or public interest (e.g., utility activities, telecommunications, and management of goods of public interest). In practice, several methods of cooperation between public and private sectors are possible, but on the basis of the existing regulation, the establishment of such cooperation is limited to the level of self-government units. The PPP conception and status comprise:

- establishment of economic entities, institutions and other organizations for rendering utility services by public sector organizations (city, municipality, public company) and private partner (natural person or legal person);
- transferring rights of rendering utility services to a private partner by contract (paying attention to the principle of competition and transparency);
- contract on concession;
- privatization;
- public procurement of services;
- public service rendering.

PPP can be divided into two basic types:

- Institutionalized: the joint establishment of a new legal person with the aim of the project implementation
- Contractual: cooperation based on a contract

Status (institutionalized) public-private partnership entails the model of a long-term cooperation between public and private sectors in projecting, constructing and/or reconstructing of public infrastructure or performing activities i.e. businesses in the scope of public authorities. The public partner establishes a joint economic entity with a private partner or a private partner becomes the owner (through partial privatization) of part of state capital in the public company or economic entity, whose founder is the state, territorial autonomy or local self-government.

A private partner projects, finances, constructs, maintains and manages the facility and charges fees but without the ownership transfer obligation to the public sector. Contractual public-private partnership implies a long-term partnership relation between a public partner and a natural or legal person in the field of projecting, constructing and/or reconstructing public infrastructure or performing activities, i.e. businesses from the scope of public government which is based on a contract on mutual rights and obligations. Therefore, private and public partners do not establish a new commercial entity and a private partner does not have a share in the public company.

6. OPTION ANALYSIS

6.1 Methodology

An integrated waste management system needs to be a sustainable system which is economicallyaffordable, socially acceptable and environmentally effective.

- Economic affordability requires that the costs of waste management systems are affordable to all sectors of the community served, including householders, commerce, industry, institutions, and government.
- Social acceptability requires that the waste management system meets the needs of the local community, and reflects the values and priorities of that society.
- Environmental effectiveness requires that the overall environmental burdens of managing waste are reduced, both in terms of consumption of resources (including energy) and the creation of environmental impacts.

Integrated Waste Management System (ISWM) takes an overall approach to this, involves the use of arange of different treatment options, and deals with the entire solid waste stream.Whilst it uses a combination of options, the defining feature of an ISWM system is that it takes anoverall approach to manage all materials in the waste stream in an environmentally effective,economically affordable, and socially acceptable way.An integrated waste management system consists in general of the following stages:

- Waste collection (one / two / three or more bin collection system)
- Waste transportation and transfer (to transfer station, recovery and recycling facility, treatment plant or landfill)
- Locations of waste management facilities i.e. transfer stations and integrated waste management centres
- Waste treatment (thermal, physical, chemical or biological treatment)
- Waste disposal to landfill

In particular in this study the methodology that is followed in order to create a municipal waste management system includes the following steps:

- Step 1: Collection and elaboration of data for the current situation of waste management in area of interest. These data have been analyzed in the Assessment report of the current project.
- Step 2: Estimation of the forecast of future population (urban, rural and seasonal) and future municipal waste production using different scenarios concerning the change of urban/rural population, seasonal population and the change of Waste Generation Rate (WGR) for each population category.
- Step 3: Detailed presentation via a flow chart on waste streams that will be collected separately
- Step 4: Analytical calculations of the quantities of waste stream that will remain and will be transferred to the “Drisla” RWMC for further treatment, through Transfer Stations or directly.
- Step 5: Multi-criteria analysis of alternative solutions - scenarios in order to conclude which

solution - scenario is the preferable for waste management in area of interest.

In accordance with existing adopted documents related to the establishment of integrated waste management system in the region of Skopje (i.e. Regional Waste Managemet and Drisla Landfill Feasibility Study), the basic future concept comprise collection of recyclable waste in one bin that is transferred to a Material Recycling Facility and collection of residual waste in another bin (mixed waste bin) that is transferred to Mechanical Biological treatment plant with biodrying process. Also concept includes separate collection of green waste that is treated to a windrow composting process, home composting actions, and green points (collect small amounts of recyclables and wood), separate collection of construction and demolition waste, hazardous fraction of waste, WEEE and other special waste streams ‐ elastic, tires. All residues from treatment processes will be disposed at sanitary landfill “Drisla”.

Given that this concept has already been adopted in relevant document, and that a signed PPP contract defines the treatment method of MSW, this option analysis will not include evaluation of different options concerning the treatment of municipal solid waste and recyclables, but only analysis and comparison of different options concerning the transport of separately collected municipal waste from municipalities to the regional center.

Waste transport solutions within the regional municipal waste management, where several municipalities use jointregional center and/or landfill, can be based on direct transport of collected waste to the landfill, or that collected waste on local level be firstly transport to TS, where is unloaded, compacted and reloaded in larger capacity vehicles for consolidation, and than transport to regional treatment facility and/or sanitary landfill. The main purpose of TS is to ensure cost-effective and optimal waste transportation. Hence, two essential roles of construction a transfer station are reduction of transport cost (i.e. cost of fuel and maintenance of vehicles), and overall time reduction needed for waste collection and delivery to final disposal destination.

TS should only be implemented where they contribute to reduction of the transport costs comparing “direct haul” approach, where waste collection vehicles are used for direct waste delivery to final treatment and/or disposal destination. Implementation of TS is justified when overall annual costs of waste transport from transfer station are lower than the overall annual costs of direct transport waste transport without a transfer station.Methodology for option analysis in order to identify the municipalities where TSs should be established in Skopje region, was based on consideration the quantity of waste to should be transported through those facilities, in correlation with the distance from the “Drisla” landfill.

For each of proposed TSs, break even points related to the costs of direct or transport throught TS, were calculated. To calculate the break-even point, the following data were determined:

- Transfer Station Cost (cost to build, own, and operate transfer station, in €/t)
- Direct Haul Payload (average payload of collection truck hauling directly to WMC, in tons)
- Transfer Haul Payload (average payload of transfer truck hauling from transfer station to landfill, in tons)

- Transportation Cost (average cost of direct or transfer hauling, €/km)
- Assumption that the mobile equipment will be replaced in 12 years from the beginning of the operation
- The investment cost of civil works and equipment of TSs in yearly basis in order to be included in the unit costs

Finnaly, after determination of the transport equipment, the type/technology of TS, and the number of TSs that should be constructed (justification performed through Break Even Point calculations), the next step was to compare the current situation (“Business as Usual”) with the “To Do Something” Scenario, namely:

- Business as usual – there is no TS in Skopje Region, each municipality uses its own existing means i.e. waste collection vehicles, open trucks, etc. to transport the waste to the “Drisla” RWMC.
- Do-something – two (2) TSs: **1 TS in Shuto Orizari** (serves Butel, Gjorche Petrov, Karposh, Saraj, Chucer Sandevo and Shuto Orizari), **and 1 TS in Gazi Baba – “Vardarishte”** (serves Gazi Baba, Arachinovo, Ilinden and Petrovets) are proposed. Direct transportation for the municipalities of Aerodrom, Kisela Voda, Centar, Chair, Zelenikovo, Studenichani and Sopishte is planned.

More detail explanation of performed methodology, and obtained results are presented in the following Chapters.

6.2 Project determination and its objectives

Already since 2008 the European Waste Framework Directive has set specific requirements for waste management, among which the most notable is the waste hierarchy. Following the waste hierarchy, waste prevention is the worthwhile goal, followed by preparing for re-use, recycling, other recovery, e.g.energy recovery, and lastly disposal as the last resort for waste that cannot be further recovered.

Therefore, a shift away from landfill in the current waste management system is crucial. The necessary changes will require the development of an appropriate infrastructure to provide an integrated network of separate waste collection, transportation, recycling facilities, recovery installation and EU conform disposal facilities. The proposed changes in the next phase should reduce the amount of waste being landfilled.

Identified gaps and measures to be taken within the currentwaste management system, are already presented in the respective RWMP, concern the following topics:

A. EU and national targets/ Local Policy

- Diversion of biodegradable municipal waste

- Targets for collection and treatment of packaging waste: paper and cardboard packaging, metal packaging, plastic packaging and glass packaging from households and other sources, if possible, when such waste streams are similar to household waste.

- Waste prevention

- Landfill restoration and/ or landfill closure

B. Financial mechanisms
- Tariffs

C. Technology and infrastructure
- Waste collection - Waste Transportation

D. Stakeholder participation - Public awareness

Upgrading with its long-term goal of becoming a 'Recycling Society', the European Union's waste policy aims at preventing waste generation and optimizing the use of waste as a resource. The key actors concretely implementing this concept are regional and local authorities as waste management falls into their responsibility[1].For the establishment of a waste management system, the **Waste Management Strategy of the Republic of Macedonia (2008 - 2020)[2](OG 39/08)** and the **National Waste Management Plan (2009 - 2015) of the Republic of Macedonia[3] (OG 77/09)** envision the construction of improved and new wastemanagement infrastructure for collection, treatment and final disposal of municipal solid waste on the regional level. Among the general goals and objectives of the waste management Strategy of the Republic of Macedonia, 3 of the main are:
-to bring under control all generated waste streams
-decrease the quantities of waste generated
-recovery of the material and energy value of waste

The overall project objective is to establish an Integrated Waste Management System in the Region. The actions will contribute to the protection of the environment and human health. The general objectives are:

- Minimization of negative impacts on the environment and human health cause by the generation and management of waste.
- Minimization of negative social and economic impacts and maximization of social and economic opportunities.
- Conformity with the legislative requirements, targets, principles and policies set by the European and National legal and regulatory framework.

The specific objectives of the project are to:

- increase the percentage of separately collected waste,
- increase recycling and re-use of waste,
- achieve the recycling of a minimum of 55% and a maximum of 80% of the weight of packaging waste, by the end of the year 2020, according to the article 35 of the Law on management of Packaging and

[1]http://www.regions4recycling.eu/R4RTheProject/background_and_objectives
[2] http://www.moepp.gov.mk/wp-content/uploads/2014/09/Strategija%20za%20upravuvanje%20so%20otpad%20na%20RM%20(2008-2020).pdf
[3] http://www.moepp.gov.mk/wp-content/uploads/2014/09/Nacionalen%20Plan%20za%20upravuvanje%20so%20otpad%20(2009-2015)%20na%20RM%20.pdf

Packaging waste[4]

• achieve the minimum recycling targets for packaging waste, according to the article 35 of the Law on management of Packaging and Packaging waste, as will be described further in more detail
• reduce the amount of biodegradable waste in municipal waste,
• reduce the amount of waste deposited in landfills,
• contribute to the reduction of the amount of biodegradable waste deposited in landfills, according to the article 87 of the LoWM of the Republic of Macedonia
• reduce the harmful effects of waste on the environment,
• plan and implement waste prevention measures,
• enable a sustainable municipal waste management system.

Article15,par.(1)oftheLawonWasteManagement(LoWM)[5],statesthat"*thecompetentauthoritiesof theRepublicofMacedonia, municipalities andtheCityofSkopje,aswellaslegalandnaturalpersons managingwastein accordance with this Law shalladoptand implement strategic, planning and programdocumentsforwastemanagementinorderto:*
1)provideenvironmentalprotection,lifeandhealth;
2)achievetheobjectivesandguidelineslaiddownintheNationalEnvironmentalActionPlan;
3)applythegeneralprinciplesandguidelinesforwastemanagement;
4)establishanintegratednationalnetworkoffacilitiesandinstallationsforprocessinganddisposalof waste
5) fulfill the obligationsrelatedtowastemanagement,whichtheRepublicofMacedoniahas undertaken atinternationallevel."

Furthermore,Article16,par.(2)oftheLoWM,statesthat"*theStrategyforwastemanagementshall:*
1)determinebasicguidelinesformanagingalltypesofwaste;
2)improvethegeneralsituationinwastemanagement
3)determinethenecessarylegalmeasuresfortheimplementationoftheplanforwastemanagement;
4)termneedsoftheRepublicofMacedoniainthefieldofwastemanagement;
5)determinethestrategicapproachtothedevelopmentofpublicawarenessandeducationregarding wastemanagementand
6)determineotherissuesofimportanceforthedevelopmentofwastemanagement."

The following targets must be achieved by the proposed waste management system in order to contribute to Republic of Macedonia's national targets:

As already briefly mentioned above, according to the article 35 (National aims for treatment of packaging waste), paragraphs (1) b, (1) c & (1) d of Law on management of Packaging and Packaging waste the following should be fulfilled:

[4] http://www.moepp.gov.mk
[5] http://www.moepp.gov.mk/wp-content/uploads/2014/09/Zakon%20za%20Upravuvanje%20so%20Otpadot.pdf

- By the end of the year 2020, a minimum of 55% and a maximum of 80% of the weight of packaging waste created on the territory of the Republic of Macedonia, needs to be recycled
- By the end of the year 2020, the following percentages of materials from the packaging waste produced need to be recycled:
  (i) 60% by weight for glass;
  (ii) 60% by weight for paper and cardboard;
  (iii) 50% by weight for metals;
  (iv) 15% by weight for wood
- Also, by the end of the year 2018, 22.5% by weight for plastic, considering only the recyclable materials in the plastic.

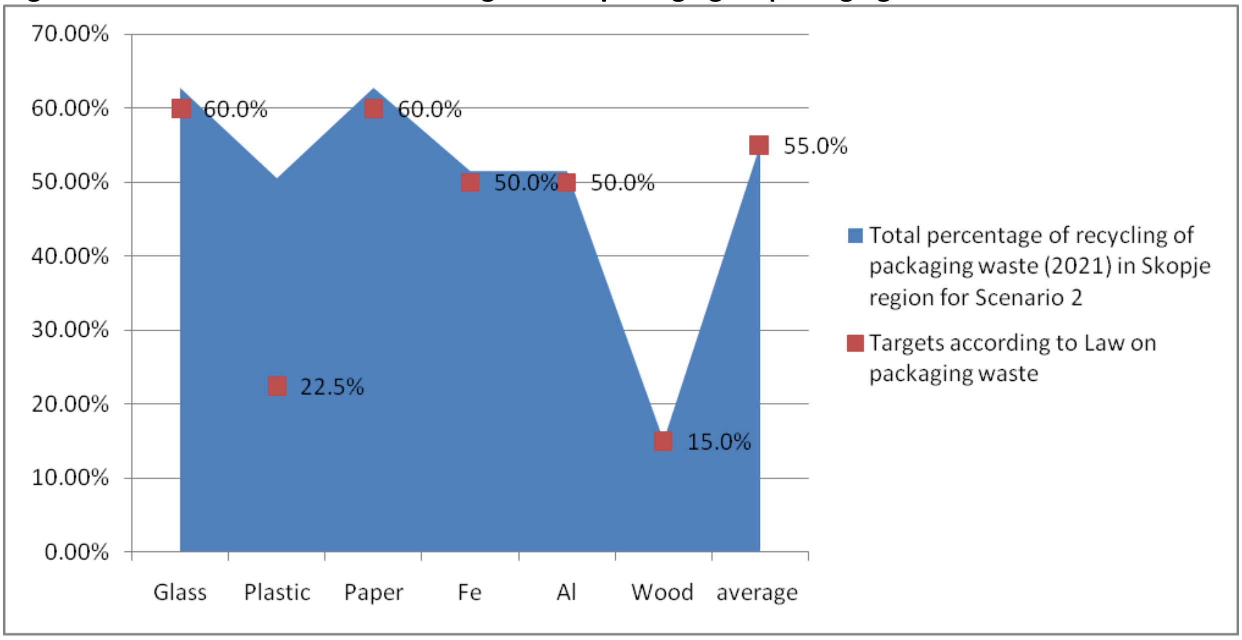
Furthermore,article87oftheLoWMoftheRepublicofMacedonia specifiesthereductionofthe quantityofBiodegradableMunicipalWaste(BMW)landfilled,expressedasapercentagereductionof theBMWgeneratedat1995:

1. by31stDecember2016thereductionmustbe25%,thatisamaximumallowablemassof228,750t BMW
2. by31stDecember2019thereductionmustbe50%,thatisamaximumallowablemassof152,500t BMW
3. by31stDecember2026thereductionmustbe65%,thatisamaximumallowablemassof106,750t BMW

EspeciallyforSkopjeRegion, themaximumallowablemassofBMWwhichmaybedepositedannually inlandfillshallbe:
▪*65,388t*by31stDecember2016
▪*43,592t*by31stDecember2019
▪*30,514t*by31stDecember2026

The quantification of the aforementioned targets is presented in the following figures and tables.

Figure6-1:QuantificationofLawonManagementofpackagingandpackagingwasteforselected scenario2



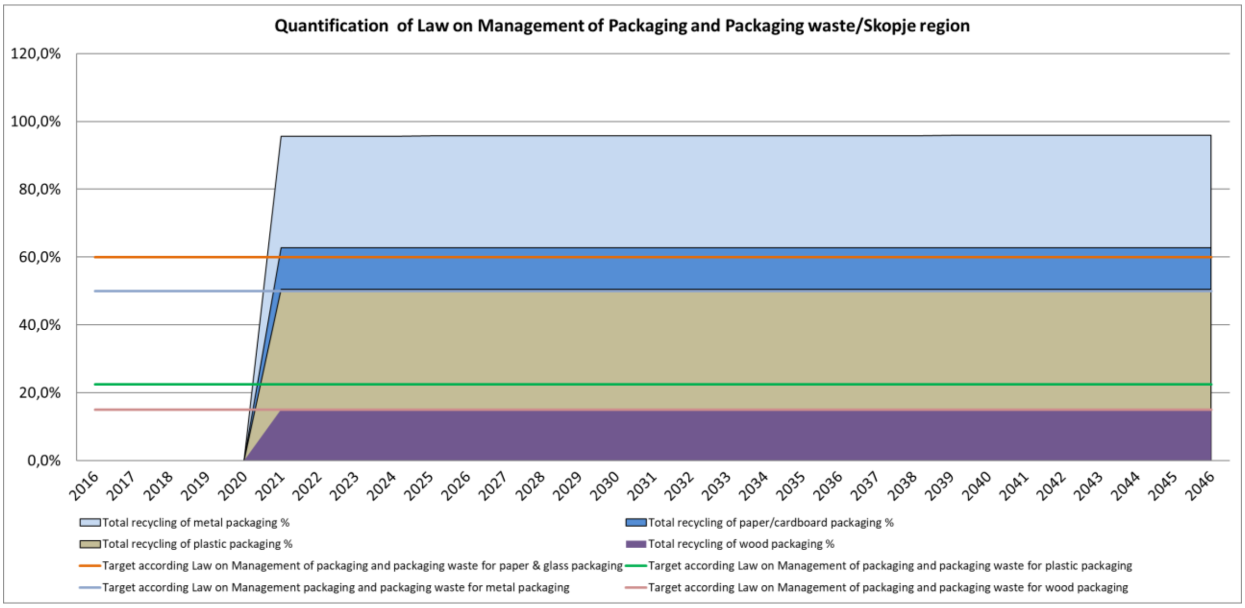
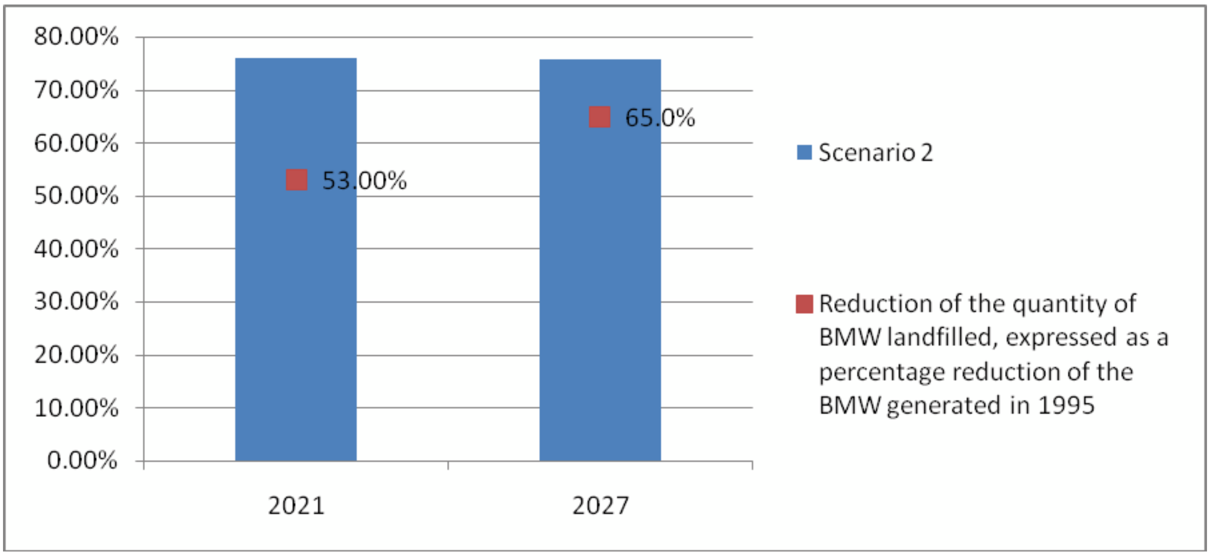


Table 6-1:Quantification of Law on Management of Packaging and Packaging waste

YEAR	Total Produced Packaging waste in Skopje region (t)	Total recycling of packaging waste (t)	Target that must be fulfilled according to the Law on Management of Packaging and Packaging waste (t)	Total recycling of packaging waste %
2016	49,140		27,027	
2017	49,997		27,498	
2018	50,846		27,965	
2019	52,433		28,838	
2020	53,985		29,692	
2021	54,222	31,028	29,822	57.2%
2022	54,464	31,167	29,955	57.2%
2023	54,708	31,307	30,089	57.2%
2024	54,955	31,448	30,225	57.2%
2025	55,204	31,591	30,362	57.2%
2026	55,460	31,738	30,503	57.2%
2027	55,720	31,886	30,646	57.2%
2028	55,983	32,037	30,790	57.2%
2029	56,249	32,190	30,937	57.2%
2030	56,519	32,345	31,085	57.2%
2031	56,605	32,394	31,133	57.2%
2032	56,692	32,444	31,181	57.2%
2033	56,781	32,496	31,230	57.2%
2034	56,872	32,548	31,280	57.2%
2035	56,965	32,601	31,331	57.2%
2036	56,986	32,614	31,342	57.2%
2037	57,009	32,627	31,355	57.2%
2038	57,033	32,641	31,368	57.2%
2039	57,059	32,657	31,383	57.2%
2040	57,086	32,672	31,398	57.2%
2041	57,053	32,653	31,379	57.2%
2042	57,021	32,635	31,361	57.2%
2043	56,990	32,618	31,344	57.2%
2044	56,960	32,601	31,328	57.2%
2045	56,932	32,585	31,313	57.2%
2046	56,855	32,541	31,270	57.2%

Figure 6-2: Quantification of LoWM Article 8 regarding biodegradable municipal waste landfilled for selected scenario 2



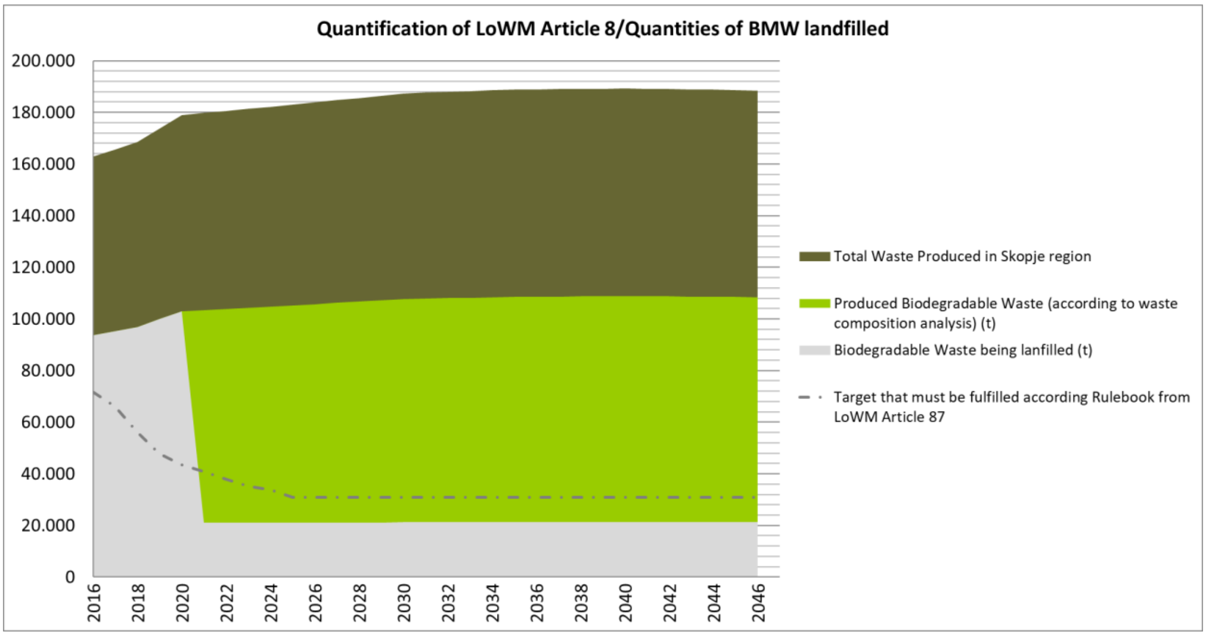


Table 6-2: Quantification of LoWM Article 8 regarding biodegradable municipal waste landfilled for selected scenario

YEAR	Total Waste Produced in Skopje region	Produced Biodegradable Waste (according to waste composition analysis) (t)	Target that must be fulfilled according Rulebook from LoWM Article 8 (t)	Biodegradable Waste being landfilled (t)
2016	162,883	93,661	71,716	93,661
2017	165,725	95,296	66,091	95,296
2018	168,539	96,914	56,248	96,914
2019	173,801	99,940	47,811	99,940
2020	178,944	102,897	43,592	102,897
2021	179,729	103,348	40,780	21,004
2022	180,531	103,809	37,967	21,024
2023	181,340	104,275	35,155	21,045
2024	182,158	104,745	33,749	21,065
2025	182,985	105,221	30,936	21,086
2026	183,834	105,709	30,936	21,108
2027	184,694	106,203	30,936	21,129
2028	185,565	106,704	30,936	21,151
2029	186,448	107,212	30,936	21,174
2030	187,343	107,727	30,936	21,196
2031	187,627	107,890	30,936	21,203
2032	187,917	108,057	30,936	21,211
2033	188,213	108,227	30,936	21,218
2034	188,514	108,400	30,936	21,226
2035	188,821	108,577	30,936	21,233
2036	188,892	108,617	30,936	21,235
2037	188,968	108,661	30,936	21,237
2038	189,048	108,707	30,936	21,239
2039	189,134	108,756	30,936	21,241
2040	189,224	108,808	30,936	21,244
2041	189,113	108,744	30,936	21,241
2042	189,006	108,683	30,936	21,238
2043	188,904	108,624	30,936	21,236
2044	188,806	108,568	30,936	21,233
2045	188,713	108,515	30,936	21,231
2046	188,456	108,367	30,936	21,224

The targets derived from Directive 2008/98/EC are also quantified for Skopje region and the results are presented in the following figure and table.

Figure 6-3: Quantification of Dir. 2008/98/EC for selected scenario 2 in Skopje region

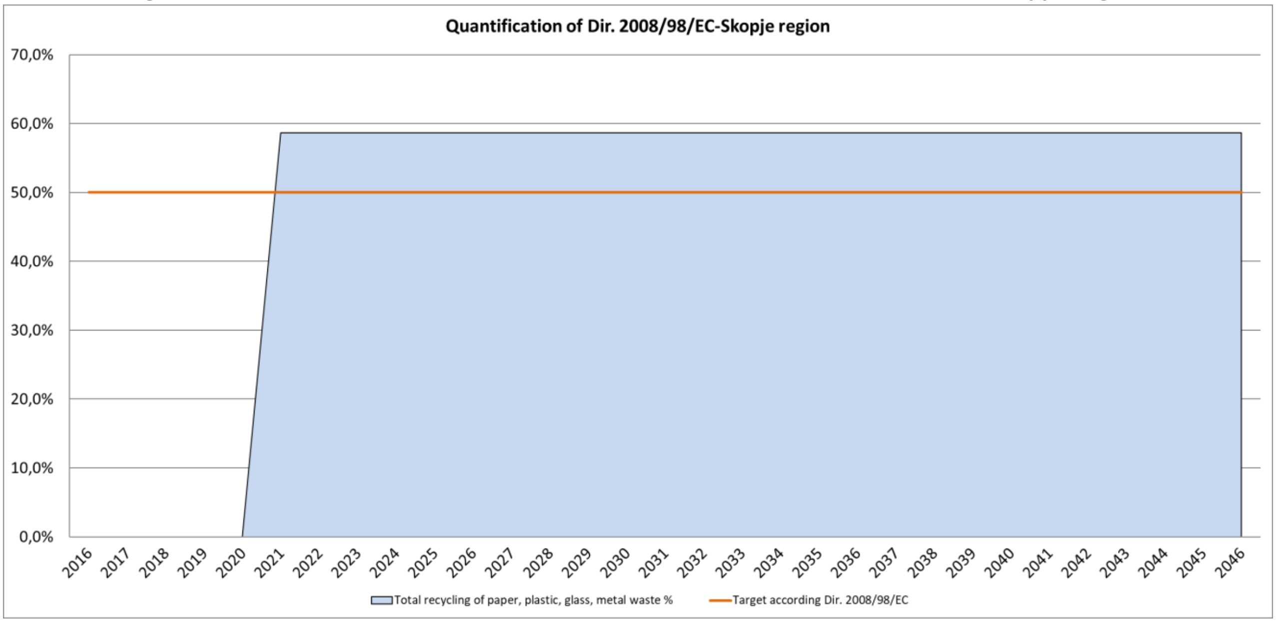


Table 6-3: Quantification of Dir. 2008/98/EC for selected scenario 2 in Skopje region

YEAR	Total Produced recyclable waste (t)	Total recycling of paper, plastic, glass, metals waste (t)	Total recycling of paper, plastic, glass, metal waste %	Target according Dir. 2008/98/EC
2016	64,267	0	0.0%	50%
2017	65,389	0	0.0%	50%
2018	66,499	0	0.0%	50%
2019	68,575	0	0.0%	50%
2020	70,605	0	0.0%	50%
2021	70,914	41,582	58.6%	50%
2022	71,231	41,767	58.6%	50%
2023	71,550	41,955	58.6%	50%
2024	71,873	42,144	58.6%	50%
2025	72,199	42,336	58.6%	50%
2026	72,534	42,533	58.6%	50%
2027	72,873	42,732	58.6%	50%
2028	73,217	42,934	58.6%	50%
2029	73,565	43,139	58.6%	50%
2030	73,919	43,346	58.6%	50%

2031	74,031	43,412	58.6%	50%
2032	74,145	43,479	58.6%	50%
2033	74,262	43,548	58.6%	50%
2034	74,381	43,618	58.6%	50%
2035	74,502	43,690	58.6%	50%
2036	74,530	43,706	58.6%	50%
2037	74,559	43,724	58.6%	50%
2038	74,591	43,743	58.6%	50%
2039	74,625	43,763	58.6%	50%
2040	74,661	43,785	58.6%	50%
2041	74,617	43,759	58.6%	50%
2042	74,575	43,735	58.6%	50%
2043	74,534	43,712	58.6%	50%
2044	74,496	43,689	58.6%	50%
2045	74,459	43,668	58.6%	50%
2046	74,358	43,609	58.6%	50%

In case of inadequate finance of the Project, it is proposed that priority investments order be as follow:
a) supply of collection bins and trucks
b) construction of TSs
c) closure and rehabilitationofnon-compliantmunicipallandfillsanddumpsites.

6.3 Option analysis for Transfer Stations

6.3.1 Option analysis for location of TSs-Selected site description

The selection of the appropriate location for the construction of Transfer Stations is an important issue for the successful implementation of an Integrated Solid Waste Management System. In order to identify the municipalities where TSs should be established in the Skopje waste management region, the following steps were applied:

- The maximum possible number of TSs was determined taking into consideration the quantity of waste to be transported through those facilities in correlation with the distance to/from "Drisla" RWMC.
- Maps which illustrate (i) the location of the central waste management facility, (ii) the possible TSs, (iii) the municipalities which will be served for each TS and (iv) the Municipalities which will transport their waste directly in CWMF, were created.
- The Rulebook "Rules on minimum technical terms and conditions with regard to the protection of the environment that shall be met by transfer stations, the conditions to be met on the sites where the Transfer Stations should be built or set up and the time limits for waste storage in the transfer station according the type of waste" was taken into consideration.

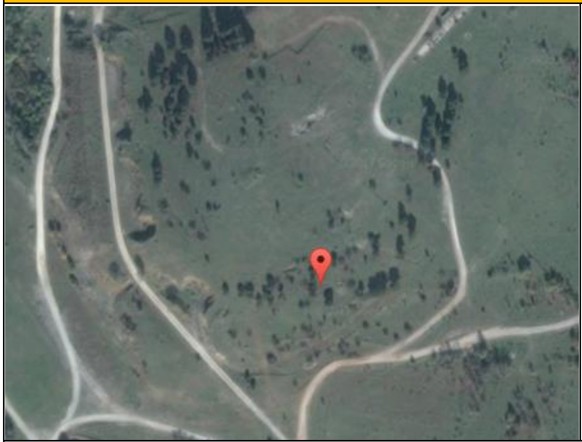
Furthermore, in order to define appropriate locations for the construction of Transfer Stations in Skopje region, desktop study identification as well as relevant proposals for potential locations received from municipalities and Ministry, were analyzed. For all short-listed potential locations for construction of Transfer Stations, site visit was performed on 04th of May 2017. In the following tables, main advantages and obstacles for the construction of TSs at observed locations, are presented.

Table 6-4: Main characteristics of potential location for construction of TS in Karposh

TS in Karposh – „Within recycling center“	
	
	
Advantages:	**Disadvantages:**
- Public land - Some infrastructure and equipment already exist - Lower CAPEX - Part of waste from Karposh municipality is already re-load in big press containers, - Good road connection	- Insufficient space – need to be extended - Part of woods and some objects need to be demolished - Urban area – relatively vicinity of Vardar river and urban settlements/objects

Table 6-5: Main characteristics of potential location for construction of TS in Chucher Sandevo

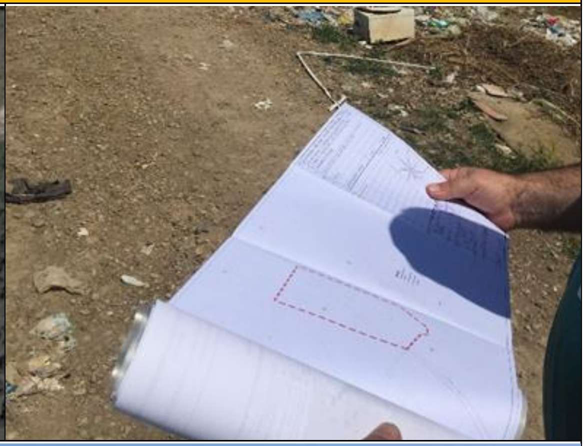
TS in Chucher Sandevo – „Gluvo Brazda“



Advantages:	Disadvantages:
- Public land - Sufficient space - Good position in relation to the other municipalities - Good (external) road connection	- Municipality of Chucher Sandevo don’t want TS on their territory - No existing infrastructure (additional investments in access road, water/sewage system, permissions, etc.) - Relatively hilly area

Table 6-6: Main characteristics of potential location for construction of TS in Petrovec

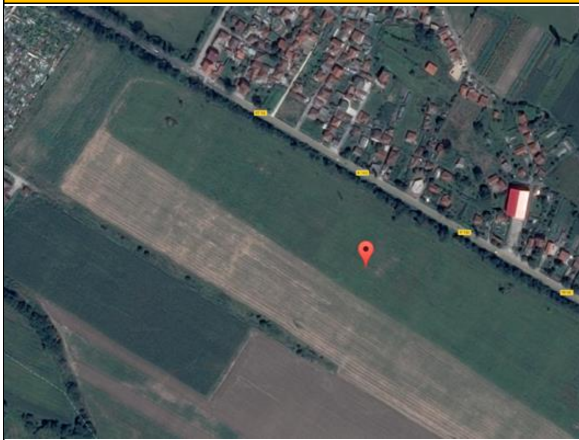
TS in Petrovec



Advantages:	**Disadvantages:**
- Public land - Sufficient space - Some internal planning documents already exist	- Not good position in relation to the other municipalities (economically is not justified) -No existing infrastructure (high investments in access road, water/sewage system, permissions, etc.) - Existing dumpsite - Remediation and stabilization measures prior construction needed

Table 6-7: Main characteristics of potential location for construction of TS in Gazi Baba

TS in Gazi Baba – „Naovo Drma“



Advantages:	Disadvantages:
- Public land (currently used by prison) - Proposed by municipality (no „acceptance“ issue) - Sufficient space - Relatively good position in relation to the other municipalities - Good (external) road connection	- Relatively vicinity of settlements/objects - Some infrastructure objects (i.e, power line maybe should be moved) - Agriculture land - Some access streets are narrow for big trucks

Table 6-8: Main characteristics of potential location for construction of TS in Gazi Baba

TS in Gazi Baba – „near highway“

Advantages:	Disadvantages:
- Public land - Sufficient space - Good position in relation to the other municipalities and gravity of waste generation - Good (external) road connection - No high CAPEX for access roads	- Relatively vicinity of some „green house“ objects - Some potential influence on traffic during construction and operation phase - Possible use of land for other purposes by municipality

Based on detail analysis of all short-listed potential locations, apart from previously described locations, three of them were chosen and proposed for further calculations (with characteristics described in below sections), namely:

- TS in Shuto Orizari – "Shuto Orizari"
- TS in Gazi Baba – "Vardarishte"
- TS in Morani – "Morani"

For each of proposed TS, break even points were calculated. To calculate the break-even point, the following data was determined:

- Transfer Station Cost (cost to build, own, and operate transfer station, in €/t)
- Direct Haul Payload (average payload of collection truck hauling directly to WMC, in tons)
- Transfer Haul Payload (average payload of transfer truck hauling from transfer station to landfill, in tons)
- Transportation Cost (average cost of direct or transfer hauling, €/km)
- Assumption that the mobile equipment will be replaced in 12 years from the beginning of the operation
- The investment cost of civil works and equipment of TSs in yearly basis in order to be included in the unit costs

- Letter of request was sent to the selected municipalities (identified after analytical calculations) in order to propose sites for the establishment of the TSs. In order to facilitate the search of the proper location, the required size of the plot area was determined from the project team.

The analytical calculations concerning the Transfer Stations are presented in a next paragraph of the present chapter. Based on performed calcualtions, final decision for the municipalities in which Transfer Stations are proposed to be constructed are:(i) Shuto Orizari and (ii) Gazi Baba. The following table presents the municipalities which will be served by each TS.

Table6-9:TSsandmunicipalitieswhichwillbeserved

TS	Served Municipalities
„Shuto Orizari"TS – Shuto Orizari	Butel, Gjorche Petrov, Karposh, Saraj, Chucer Sanedevo and Shuto Orizari
„Vardarishte"TS – Gazi Baba	Gazi Baba, Arachinovo, Ilinden and Petrovets

The municipalities of Aerodrom, Kisela Voda, Centar, Chair, Zelenikovo, Studenichani and Sopishte, will transfer their waste directly to the "Drisla" waste management Center.

Although initial idea of having 1 TS for whole "north" part of Skopje region was considered (especially considering that proposed TSs are relatively close to each other, i.e., about 15km), choosing one of them as a central TS, will be technically and economical challenging for the most distant municipalities like Saraj, Petrovec, Chucher Sandevo, etc. Besides, defining "new" central TS (apart from 2 proposed) is very difficult in terms of finding appropriate parcel (with sufficient area, public ownership, in vicinity of road network, enough away from venerable environmental objects, etc.). Moreover, infrastructure which already exist at 2 proposed TS will not be used in that case, causing higher CAPEX for construction. Potential 1 bigger TS will need to be with sufficiently capacity to accept 95,000 t of MSW per year and manage trucks from 10 municipalities, which is very challengeable for "smooth" operational process.

„Shuto Orizari"TS – Shuto Orizari

- The site which was proposed by Shuto Orizari Municipality, and it is located in northeast part of municipality
- The total surface of the proposed site is 2.6 ha
- The closest Emerald site is Matka site (MK0000009) in a direct distance of approx 12,7 km W-NW of proposed site.
- The nearest settlement is Shuto Orizari settlement
- The access to the site is through the A2 road.

The following figures illustrate the plot area of the proposed site and the settlements in the vicinity of the TS site.

Figure 6-4: Plot area of the proposed site, boundaries of closest Emerald areas/Shuto Orizari TS

"Vardarishte" TS - Gazi Baba

- The site which was proposed by Municipality of Gazi Baba, is located near Vardar river
- The total surface of the proposed site is approx. 4.25 ha
- The closest Emerald site is Katlanovo Taor site (MK0000030) in a direct distance of approx 13.5 km south of proposed site.
- The nearest settlement is Gazi Baba
- The access to the site is through the road R 1102

The following figures illustrate the plot area of the proposed site and the access road for the specific site.

Figure 6-5: Plot area of the proposed site, boundaries of closest Emerald areas/"Vardarishte"-Gazi Baba TS

6.3.2 Option analysis on transfer stations

Solid waste Transfer Stations (TS) are solid waste reception facilities that are used as interim stations for waste transportation to distant waste treatment and disposal facilities. They can play an important role in the regions total waste management system as a link between the collection system of solid municipal waste and their final disposal.

While TS facilities may vary, all serve a same basic purpose, to consolidate the waste from multiple collection vehicles into larger, high-volume transfer vehicles. Their advantages are summarised as follows:

- Economically transport waste to a distant landfill
- Increase municipal collection efficiency
- Provide convenient drop-off locations for residents
- Reduce traffic volume at a landfill

Consolidating smaller loads from collection vehicles into larger transfer vehicles reduces hauling costs by enabling collection crews to spend less time traveling to and from distant disposal sites and more time collecting waste, resulting in reduced fuel consumption and collection vehicle maintenance costs, plus produces less overall traffic, air emissions, and road wear.

A transfer station also provides an opportunity to screen waste prior to disposal, flexibility in selecting waste disposal options, as well as an opportunity to serve as a convenience center for public use.

In their simplest form, transfer stations are facilities with a designated receiving area where waste collection vehicles discharge their load, but in some cases, transfer stations are also used as multi- purpose facilities that include: storage of recyclable materials, household hazardous waste collection depots, and in some cases collection points for organic materials destined for composting sites.

Social, political, economical and geographical factors establish the need of transfer station in a region and the primary reason for using a transfer station is to reduce the cost of transporting waste to treatment/disposal facilities.Deciding whether a transfer station is appropriate for an individual community is based on determining if the benefits outweigh the planning, sitting, designing, and operating costs against the savings the transfer station might generate from reduced hauling costs.

The type of station that will be feasible for a community depends on the following design variables:

- Required capacity and amount of waste storage desired;
- Types of wastes received;
- Processes required recovering material from wastes or preparing it (e.g. shred or bale) for shipment;
- Types of collection vehicles using the facility;
- Types of transfer vehicles that can be accommodated at the disposal facilities, and;
- Site topography and access.

6.3.2.1 Waste quantities

The waste quantities that will be transferred to "Drisla" site, either directly with waste collection vehicles, or through transfer stations, are equal to **179,778 t/y**after removal ofhazardous waste, waste collected in Green Points, waste from home composting actions, and other waste streams (i.e. WEEE, construction and demolition waste, etc.).

The quantity of waste per municipality of Skopje region that will be transferred for the appropriate treatment and disposal is presenting in the following table.

Table 6-10: Waste quantities per municipality that will be transferred to "Drisla" RWMC (aver. 2021-2046)

Municipalities	Quantity(t/y)	Percentage%
Aerodrom	23,666	13.16
Butel	11,784	6.56
Gazi Baba	23,005	12.80
Gjorche Petrov	12,838	7.14
Karposh	18,684	10.39
Kisela Voda	18,761	10.44
Saraj	10,888	6.06
Centar	15,194	8.45
Chair	21,334	11.87
Shuto Orizari	7,185	4.00
Arachinovo	3,576	1.99
Zelenikovo	1,141	0.64
Ilinden	2,820	1.57
Petrovets	2,035	1.13
Sopishte	1,243	0.69
Studenichani	3,804	2.12
Chucher-Sandevo	1,811	1.01
Total	**179,778**	**100.00%**

6.3.2.2 Location and capacities of all potential transfer stations

Organized collection and transport of municipal waste will cover all settlements in seventeen (17) municipalities of Skopje Region, and 100% of the population. In addition to the local population, during the tourist season, collection and transport of waste is also cover waste by tourists and residents who occasionally stay in holiday homes, in the area of Skopje Region.As it is already mentioned the first step in the procedure of determining the possible maximum number of TSs which should be constructed was the determination of the quantities of waste that will be transferred through those facilities and the implementation of maps.

The total quantities to be transferred to the "Drisla" landfill, either directly with waste collection vehicles, or through transfer stations, are equal to 179,778 t/y (2021-2046 average waste quantity). The waste quantities to be transferred via TS vary depending on the number of TS, and the Municipalities which will be served. The waste streams which will be transferred through TSs will be (i) mixed waste, (ii) recyclable waste and (iii) green waste.The following tables present an overview of all potential TSs locations and their waste capacities and an overview of the Municipalities that will transfer their waste directly to "Drisla" RWMC, without TS. The sustainability of potential TSs will be examined through the Break Even Point Calculations.

Table 6-11: Capacities of all potential TS (average quantities 2041-2046)

Potential TS	TS to CWMF (roundtrip, km)	Served municipalities	Residual waste stream (t/y)	Recyclable waste stream (t/y)	Green waste stream (t/y)	Total capacity (t/y)
Shuto Orizari	48	Karposh	12,742	4,850	1,092	18,684
		Gjorche Petrov	8,755	3,332	751	12,838
		Saraj	7,426	2,827	637	10,890
		Chucher-Sandevo	1,235	470	106	1,812
		Shuto Orizari	4,900	1,865	420	7,185
		Butel	8,037	3,059	689	11,789
		Sub-total	***43,096***	***16,403***	***3,695***	***63,193***
Vardarishte	38	Gazi Baba	15,689	5,971	1,345	23,005
		Arachinovo	2,439	928	209	3,576
		Ilinden	1,924	732	165	2,821
		Petrovets	1,388	528	119	2,035
		Sub-total	***21,439***	***8,160***	***1,838***	***31,438***
Morani	22	Zelenikovo	779	296	67	1,142
		Studenichani	1,388	528	119	3,804
		Sub-total	***3,373***	***1,284***	***289***	***4,946***
Total quantity transported through TSs			**67,908**	**25,847**	**5,822**	**99,578**

Table 6-12: Capacities of municipalities that will transfer their waste directly to "Drisla" (average quantities 2041-2046)

Directtransportationto CWMF - Municipalities	Municipality to CWMF (roundtrip, km)	Residual waste stream (t/y)	Recyclable waste stream (t/y)	Green waste stream (t/y)	Total capacity (t/y)
Aerodrom	24	16,140	6,143	1,384	23,667
Kisela Voda	24	12,795	4,870	1,097	18,762
Centar	28	10,362	3,944	888	15,194
Chair	34	14,550	5,538	1,248	21,336
Sopishte	26	848	323	73	1,243
	Sub-total	***54,695***	***20,818***	***4,690***	***80,202***
Total quantity transported directly					***80,202***

Figure 6-6, illustrates the proposed locations, in a municipality level, and the municipalities which will be served for each proposed TS.

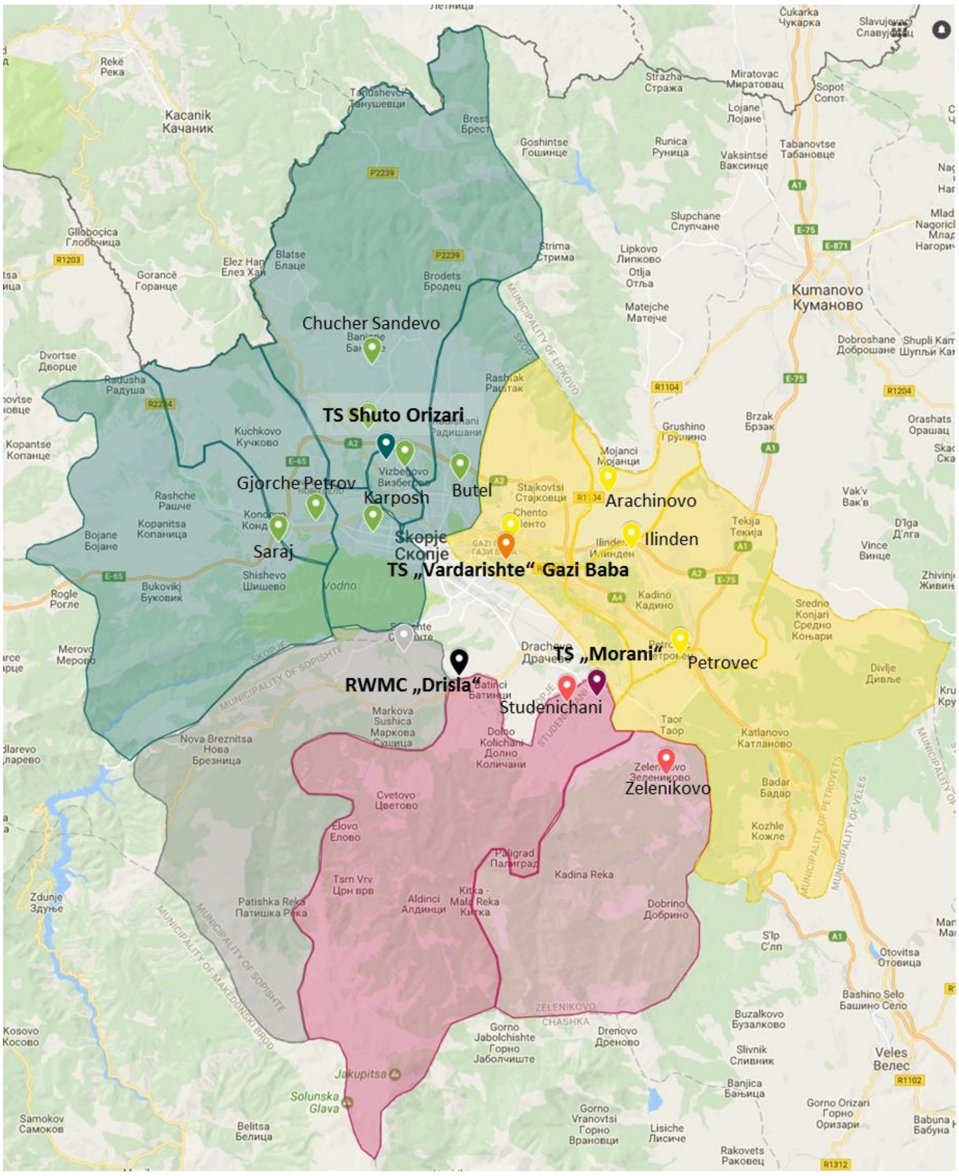


Figure 6-6: Locations of potential Transfer Stations and "Drisla" RWMC and respective served municipalities

The following diagram illustrates the proposed Transfer Stations, the municipalities which will be served from them, the municipality in which these will be located, the quantities which will be transferred through them and the municipalities and their quantities which will transfer their waste directly to the

“Drisla” landfill.

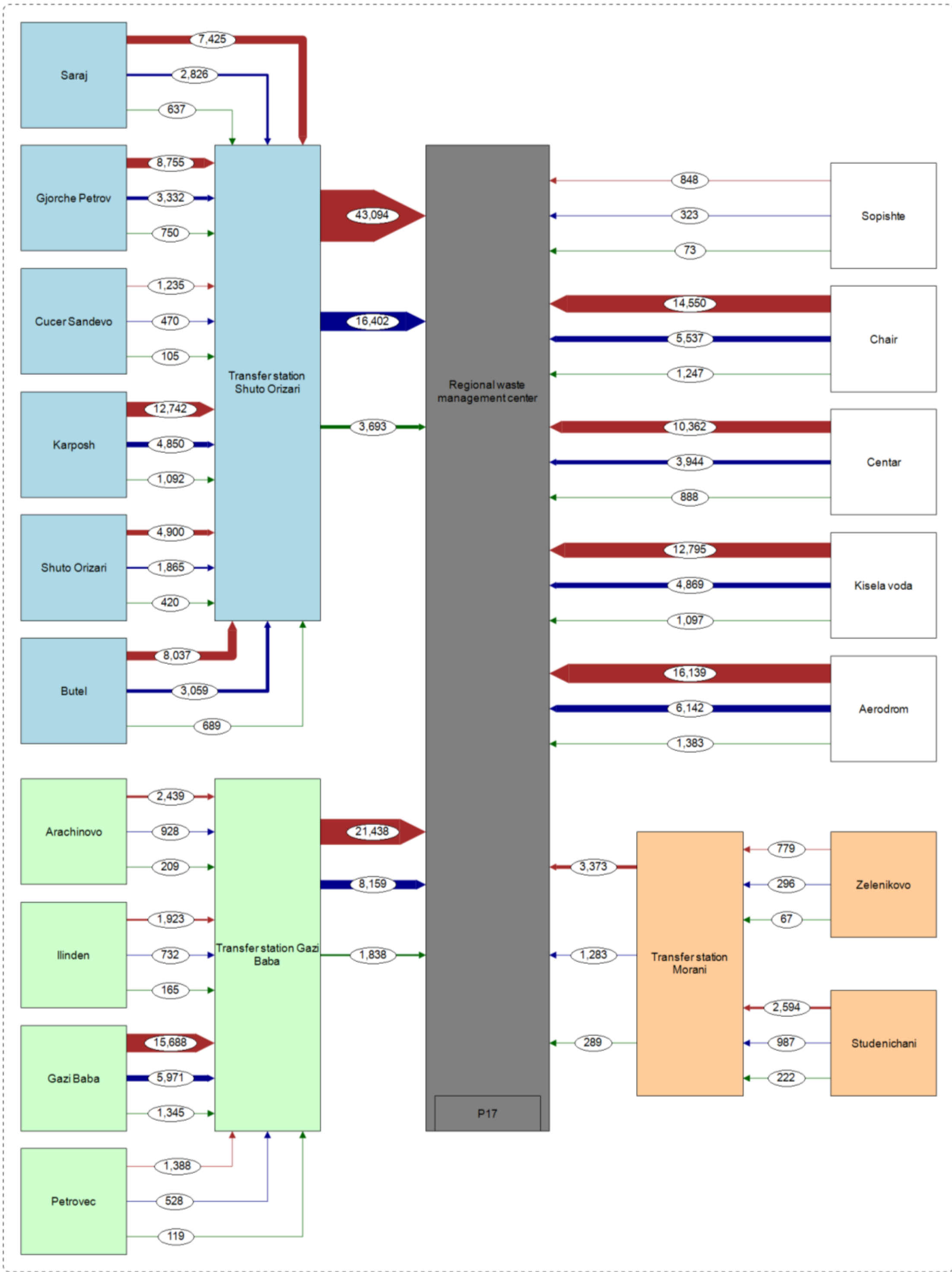


Figure 6-7: Overall proposed transportation system in Skopje region

6.3.2.3 Break Even Point calculation concerning Transfer Station task

The Break Even Points were calculated for each proposed TS of the region.To calculate the break-even point for a specific facility, it is necessary to determine the following values:

- Transfer Station Cost (cost to build, own, and operate transfer station, in €/t)
- Direct Haul Payload (average payload of collection truck hauling directly to CWMF, in tons)
- Transfer Haul Payload (average payload of transfer truck hauling from transfer station to landfill, in tons)
- Trucking Cost (average cost of direct or transfer hauling, €/km)

Once these values are known, the following formulas have been used in order to calculate cost at different distances:

- Cost of Direct Haul (without the use of a waste transfer station) Distance (km) multiplied by Trucking Cost (€ per km) divided by Direct Haul Payload (tons)
- Cost of Transfer Haul
- Transfer Station Cost (€ per ton) plus Distance (km) multiplied by Trucking Cost (€ per km) divided by Transfer Haul Payload (tons)

- Cost for build own and operate TS facility

In order to proceed with the aforementioned calculation it was necessary to determine the appropriate uploading system and transportation equipment for each Transfer Station. TS can typically be categorized into the following basic categories:

- Direct discharge without compaction systems
- Platform/pit stations without compaction systems
- Compaction systems (Stationary compactors or press containers)

<u>Direct discharge without compaction systems:</u>

Waste can be unloaded directly into the "open top" of the trailer. Direct discharge without compaction stations is generally designed in two main operating floors. During the operation the waste is unloaded directly from collection vehicles (which located on the top floor), through a hopper, into an open-top trailer which located on the lower floor. The trailer is positioned on scale so that unloading can be stopped when the maximum payload is reached. Large trailers are necessary in order to get a good payload because the waste is not compacted.

Advantages	Disadvantages

Simple technology thatdoesnot rely onsophisticatedequipment Lower capitalcosts No additionalequipmentneededfor pushingwasteinto trailer Reduces thehandlingof waste	Needsgradeseparation for top-loadingtrailers No temporary storage ofwaste Wastecanlightlycompacted Limitedinspectioncapability

Platform/pit stations without compaction systems

In platform/pit stations, collection vehicles are unloading the waste onto a floor or area where wastecan be temporarily stored, and, if desired, picked through for recyclables or unacceptable materials. The waste is then pushed into open-top trailers, usually by front-end loaders. Like direct discharge stations, platform stations have two levels. If a pit is used, the station has three levels. A major advantage of these stations is that they provide temporary storage, which allows peak inflow of wastes to be leveled out over a longer period. Although construction costs for this type of facility are usually higher because of the increased floor space, the ability to temporarily store waste allows the purchase of fewer trucks and trailers, and can also enable facility operators to haul at night or other slow traffic periods. These stations are usually designed to have a storage capacity of one-half to two days' inflow.

Advantages	**Disadvantages**
Peak waste flow can be stored. Thus reducingthenumberof transfer trailers is possible Bulky items canbebrokendown. Simple technology Easier for materials recovery andwaste screening.	Highcapitalcosts Additional equipmentis needed toreloadwaste into transfer trailer Fall hazardforpeopleand vehicles Larger floor area to maintain

Compaction systems (Stationary compactors or press containers)

Stationary compactors use a hydraulic ram to compact waste into the transfer trailer. The trailer must be designed to resist the compaction force and for this reason usually it is made of reinforced steel. Waste is fed into the compactor through a chute, either directly from collection trucks or after intermediate use of a pit. The hydraulically powered ram of the compactor pushes waste into the transfer trailer, which is usually mechanically linked to the compactor. The main disadvantage of this compaction facility is that the ability of the facility for waste process depends on the functionality of the compactor. The selection of a good quality compactor in comparison with regular preventive maintenance of the equipment and the prompt availability of relevant personnel are essential for the reliable operation.

Another alternative of compaction system, without the presence of the aforementioned disadvantage, is the system of press containers. In this solution, waste is tipped through a hopper into press containers which can be wheeled press containers or simple press containers.In the first case of wheeled press containers, these are carried through an appropriate truck which connected to the wheeled press container, while in the second case of simple press containers these are carried through a hook lift truck. When quantities of waste are small, it is economically more feasible the use of mobile compactors (press containers wheeled or simple) than stationary compactors. In this case the waste is unloaded from the collection vehicle, through a hopper, into the feeding chute of the press container which is located on a lower floor. Each mobile compactor is a single unit that consists of a compactor with a permanently connected compaction container. This has the advantage that special preparation of the site is not needed, as the only requirement of the compactor is an electrical power connection. An electro-hydraulically driven horizontal ram, compacts the material into the container.

Due to the fact that the quantities that will be transferred through Transfer Stations are relatively small (average quantity 2021-2046) and taking into consideration the advantages and disadvantages of each different type, concerning the uploading systemof the Transfer stations, the system that will be examined further is based on **a system with hopper on different levels** and regarding transportation equipment, the **system of press containers**was selected.The following figure illustrates the propsed systems for transportation equipment at Transfer Stations.

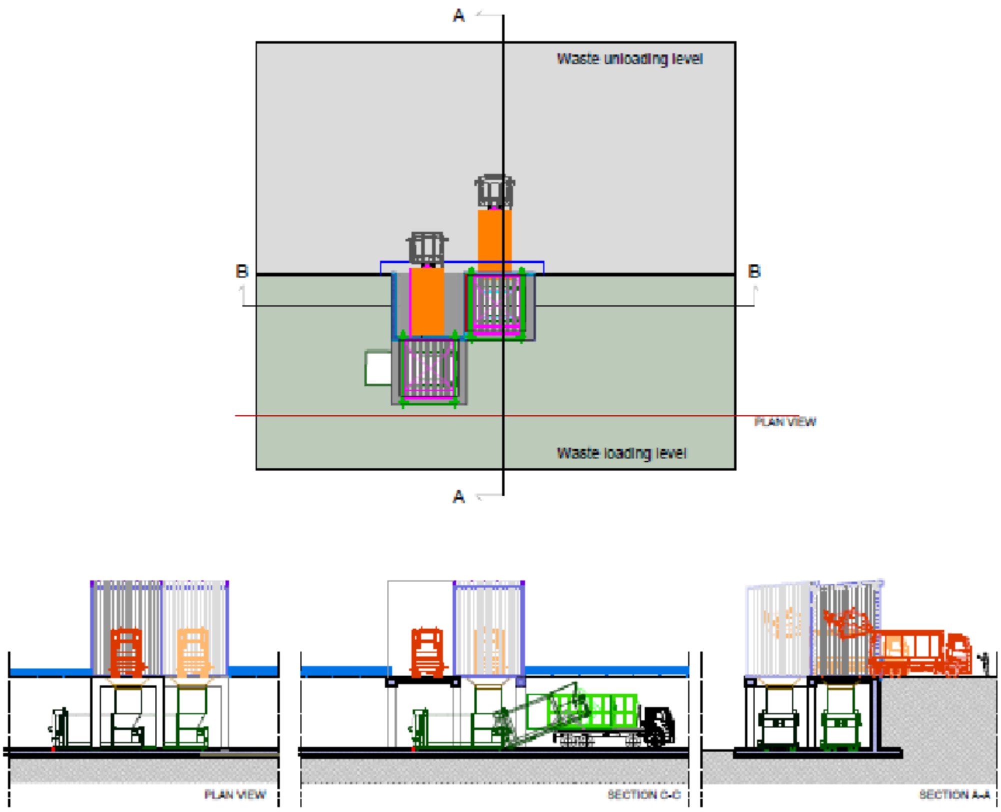


Figure 6-8: Press containers and relevant truck with hook lift for press containers

Transportation equipment of proposed type of TSs includes:

- Press containers 24 m^3 for mixed waste
- Press containers 24 m^3 for recyclable waste
- Containers 24 m^3 for green waste

- Trucks for containers/press containers

Option with press containers for mixed and recyclable waste and open containers for green waste/truck with hook lift, are selected for all the proposed TSs in Skopje region as it is the most economical solution for transportation equipment.The following table presents the total investment cost for each TS in Skopje region. Analytical calculations are presenting in the relevant Annex of the present study.

Table 6-13: Financial calculations for each alternative option and each proposed TS in Skopje region

Investmentcostfortransportation equipmentin SkopjeRegion	€/TS
Shuto Orizari TS – Shuto Orizari	952,606
VardarishteTS – Gazi Baba	515,158
Morani TS - Studenichani	234,204

**Data from table are detailed explained in Annex 2 Table 3*

The next step, after the selection of the appropriate technology for uploading system and transportation equipment, was the calculation of investment and operational cost for all the proposed TSs taking into consideration the division on civil works, equipment of the facility and mobile equipment. The following table provides the calculations for investment and operational costs for each proposed TS and the unit costs concerning the TS facility (civil works & equipment) and the transportation equipment of each TS facility. Analytical calculations are presenting in the relevant Annex.

Table 6-14: Investment/Operational cost for each proposed TS in Skopje region

CAPEX/OPEX	Shuto Orizari TS	Vardarishte TS	Morani TS
Total Investment costofTS €	1,680,549	1,173,305	605,755
Total operational costofTS €/y	326,535	199,476	98,255

**Data from table are detailed explained in Annex 2 Table 3*

Table 6-8: Unit costs for build, own and operate TS facilities

Costs	Shuto Orizari TS	Vardarishte TS	Morani TS
Unit cost for build, own and operate TS facility (€/t)	5.17	6.35	19.86

**Data from table are detailed explained in Annex 2 Table 3*

- Calculation of trucking cost

The average cost of direct or transfer hauling in €/km was also calculated for the determination of break even points. The following table presents the summarized results for each TS for the cases (i) the served municipalities transfer their waste directly to “Drisla” RWMC or (ii) through TS facilities.

Table 6-15: Average cost of direct or transferring hauling (Investment and operational cost)

Costs	Butel, Karposh, Gjorche Petrov, Saraj, Chucer Sanedevo and Shuto Orizari	Gazi Baba, Arachinovo, Ilinden and Petrovets	Zelenikovo and Studenichani

Cost fortransportation equipment through TSs (€/t)	1.34 (for average round-trip 48 km)	2.54 (for average round-trip 38 km)	11.62 (for average round-trip 22 km)
Cost fortransportation equipment through small trucks without TSs (€/t)	13.5 (for average round-trip 48 km)	14.2 (for average round-trip 32 km)	30.1 (for average round-trip 30 km)

**Data from table are detailed explained in Annex 2 Table 3*

The following figures demonstrate a representative “cost versus kilometres” relationship between direct hauling waste to “Drisla” RWMC in collection vehicles, versus hauling in larger vehicles for each proposed Transfer station in Skopje Region.

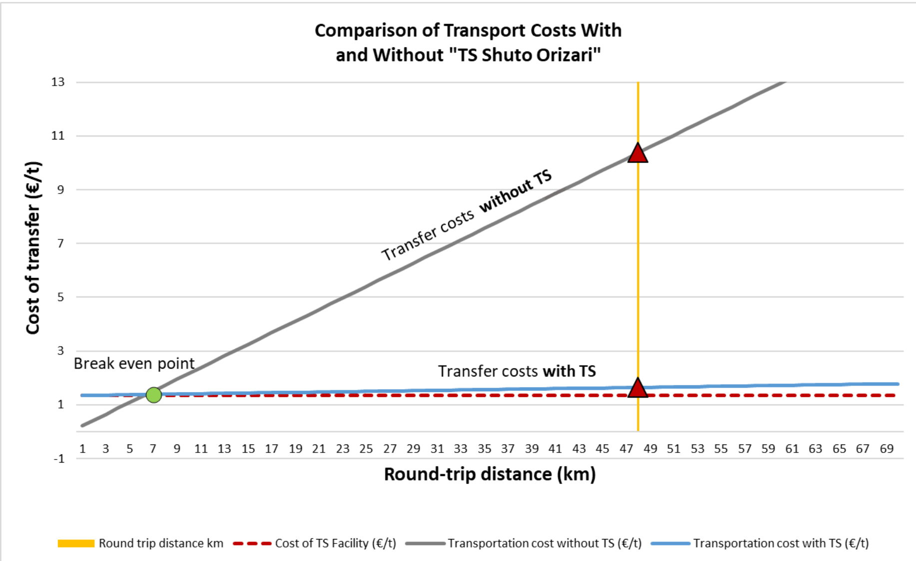


Figure 6-9: Break even point calculation for TS in Shuto Orizari(served municipalities: Butel, Gjorche Petrov, Karposh, Saraj, Chucer Sanedevo and Shuto Orizari)

The comparison shows a break-even point distance of about 7 km (round-trip), which means that is cost effective to construct this specific TS when the round-trip distance exceeds 7 km. The round-trip distance from TS location “Shuto Orizari” to “Drisla” RWMC is approximately 48 km, so Shuto Orizari TS is cost-effective and proposed to be constructed.

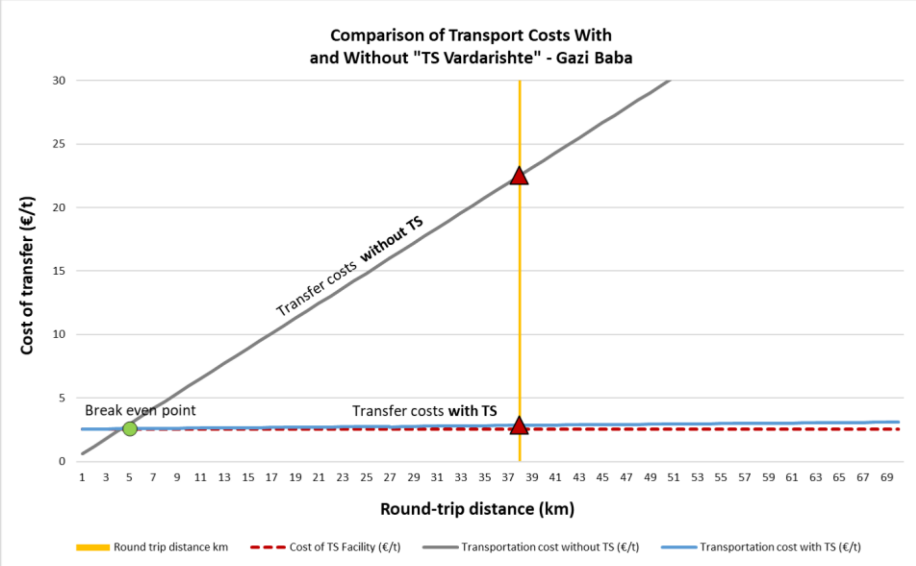


Figure 6-10 Break even point calculation for TS "Vardarishte" in Gazi Baba(served municipalities: Gazi Baba, Arachinovo, Ilinden and Petrovets)

The comparison shows a break-even point distance of about 5km (round-trip), which means that is cost effective to construct this specific TS when the round-trip distance exceeds 5km. The round-trip distance from TS location "Vardarishte" to "Drisla" RWMC is approximately 38 km, so TS in Gazi Baba is cost-effective and proposed to be constructed.

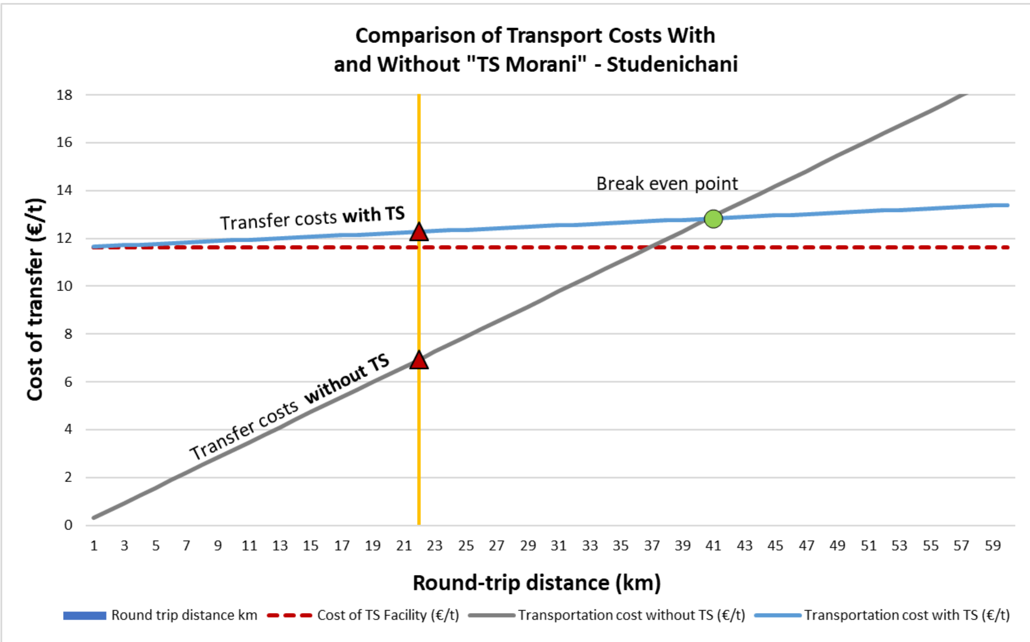


Figure 6-11: Break even point calculation for TS "Morani" – Studenichani(served municipalities: Zelenikovo and Studenichani)

The comparison shows a break-even point distance of about 42 km (round-trip), which means that is cost effective to construct this specific TS when the round-trip distance exceeds 42 km. The round-trip distance from TS location “Morani” in Studenichani municipality to “Drisla” RWMC is approximately 22 km, so Morani TS is not cost-effective, and it’s not proposed to be constructed.

Summarizing, two TSs is proposed to be constructed in Skopje region (Shuto Orizari TS and Gazi BabaTS). The following diagram illustrates those Transfer Stations, the municipalities which will be served by those TS, the municipality in which these will be located, the quantities which will be transferred through them, and the municipalities and their quantities which will transfer their waste directly to the “Drisla” RWMC.

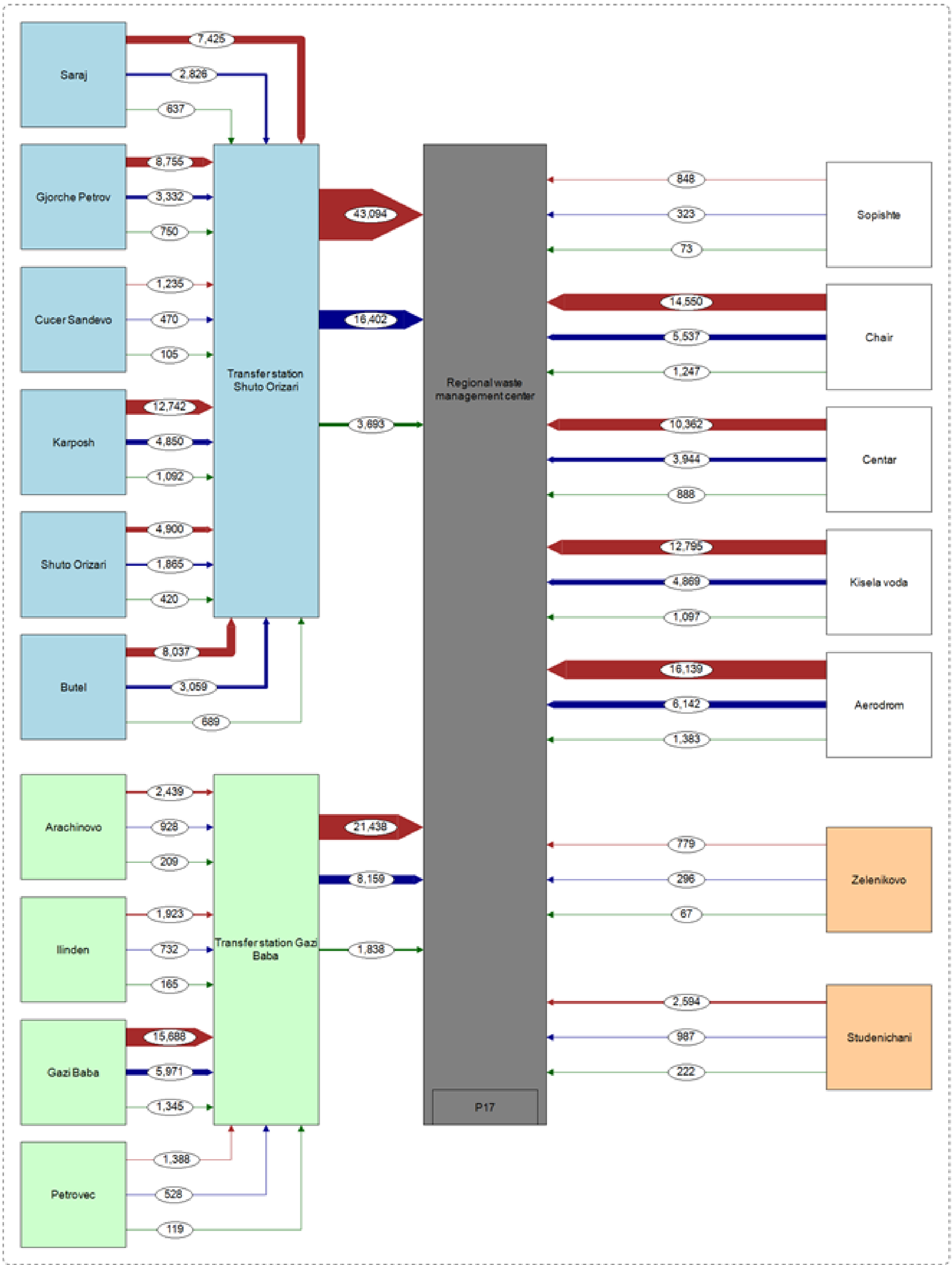


Figure 6-12: Proposed transportation system in Skopje region/2 TSs

6.3.3 Analysis of alternative scenarios for waste transportation system in Skopje Region

6.3.3.1 Description of options

Having determined in the previous paragraphs the transport equipment, the type/technology of TS, and the number of TSs that should be constructed (justification did through the Break Even Point calculations), the next step is to compare the current situation (Business as Usual) (no TSs, direct transportation to the "Drisla" landfill with collection trucks), with the "To Do Something Scenario". Namely, the two Variants are:

- **Business as usual (Variant 0)** – There is no TSs. Each municipality uses its own existing means i.e. waste collection vehicles, open trucks, etc., to transport the waste to the "Drisla" RWMC.
- **Do-something (Variant 1)** – Two (2) TSs are proposed: at Shuto Orizari and Gazi Baba,direct transportation for the municipalities of Aerodrom, Kisela Voda, Centar, Chair, Zelenikovo, Studenichani and Sopishte, is planned.

An overview of the waste quantities transferred according to the aforementioned variants to "Drisla" RWMC is presented in the following diagrammes.

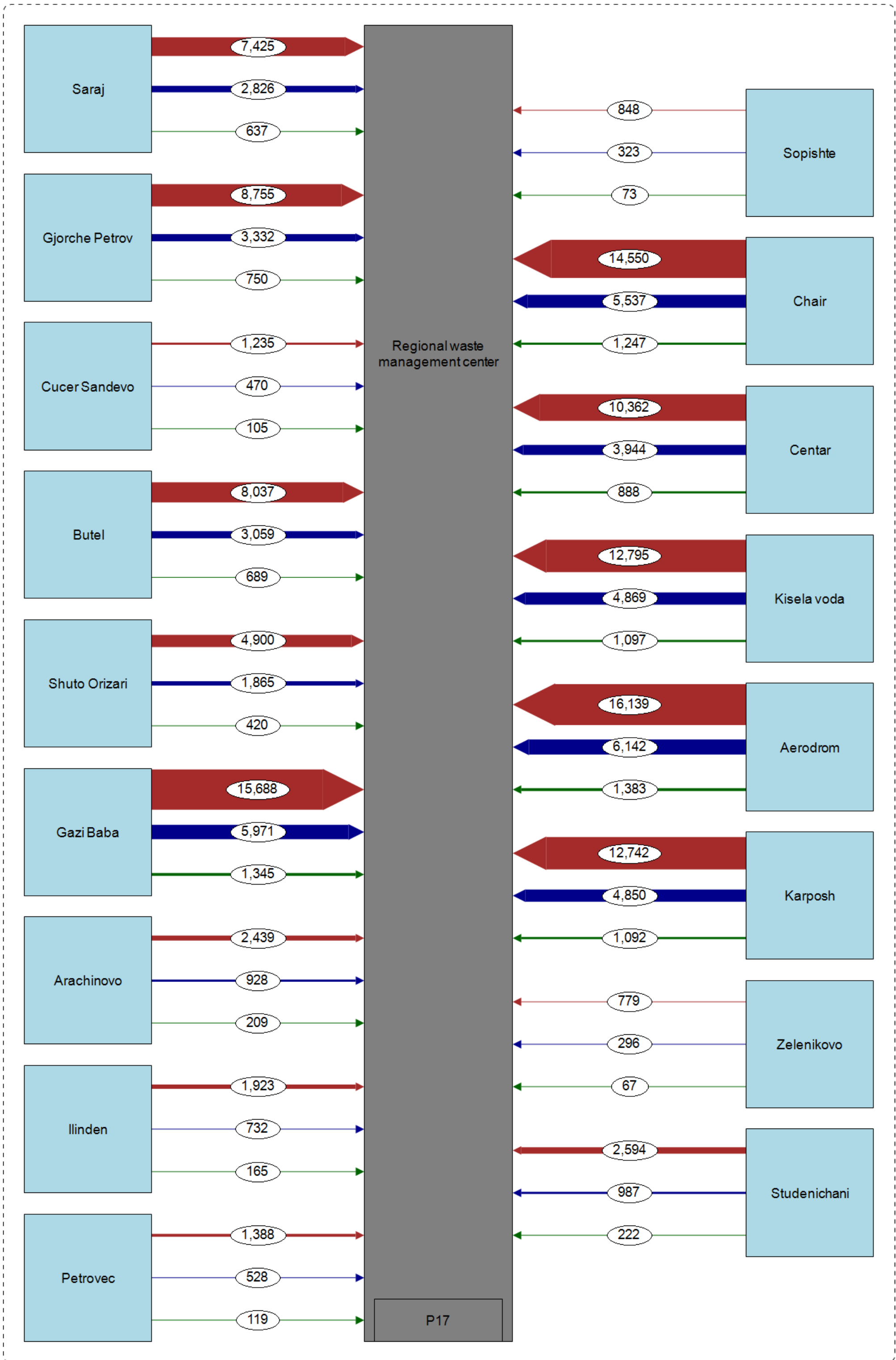


Figure 6-13a: Overwiev of alternative examined variants - Business as usual (Variant 0)

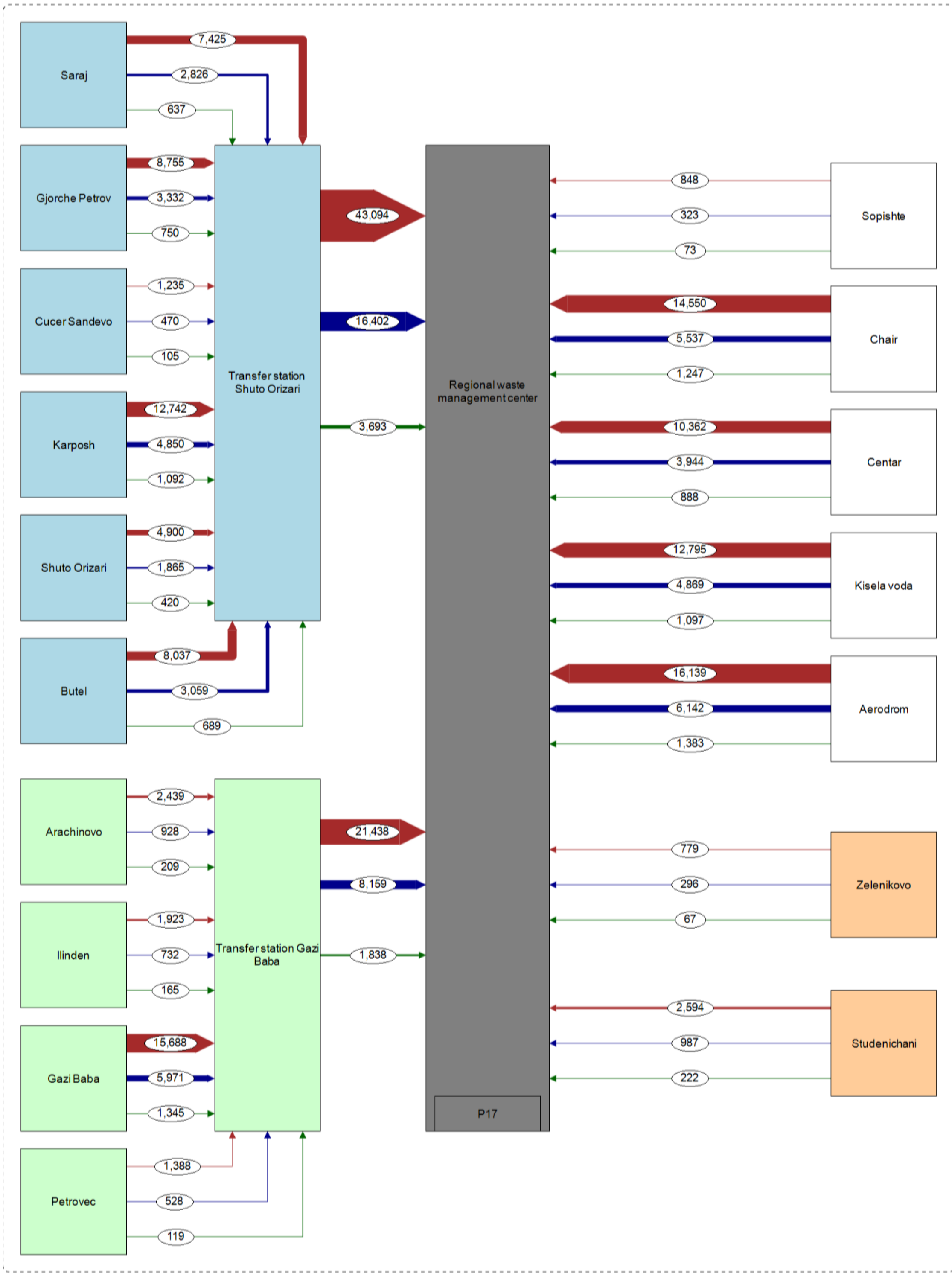


Figure 6-13b: Overwiev of alternative examined variants - Do-something (Variant 1)

For each Variant have been calculated:

- Investment costs (Cost for purchasing trucks (hook lift trucks and collection trucks), cost for civil works on TSs, cost for equipment of TSs, cost for transportation equipment of TSs)
- Operational costs (Cost for operating TS facilities, transportation cost of large hauling trucks, transportation cost of collection trucks for municipalities which will transfer their waste directly to CWMF)
- Levelized Unit Cost

6.3.3.2 Investment costs

Calculations for Variant 0

The total investment cost for collection trucks for the transportation of waste from the municipalities to “Drisla” landfill, are estimated. The following table presents obtained results.

Table 6-16: Total CAPEX for collection trucks/Waste transportation from municipalities to “Drisla” landfill (€)

Municipality	TotalInvestment cost (€)
Aerodrom	509,572
Butel	312,850
Gazi Baba	509,572
Gjorche Petrov	428,979
Karposh	741,830
Kisela Voda	509,572
Centar	312,850
Chair	509,572
Shuto Orizari	196,722
Arachinovo	312,850
Ilinden	312,850
Petrovets	312,850
Zelenikovo	196,722
Studenichani	196,722
Sopishte	312,850
Saraj	777,365
Chucher-Sandevo	312,850

**Data from table are detailed explained in Annex 2 Table 7*

Calculations for Variant 1

The total investment cost (Civil works, equipment and transportation equipment) for each one of the TSs is presented in the following table.

Table 6-17: Total CAPEX per TS (€)

	Shuto Orizari TS	Vardarishte TS
Total investmentcost €	1,680,549	1,173,305

**Data from table are detailed explained in Annex 2 Table 3*

The following table presents the total investment cost concerning collection trucks for the municipalities that will transfer their waste directly to CWMF.

Table 6-18: Total CAPEX for collection trucks/ Aerodrom, Kisela Voda, Centar, Chair, Zelenikovo, Sopishte&Studenichani (€)

Municipality	TotalInvestment cost (€)
Aerodrom Kisela Voda Centar Chair	751,352
Zelenikovo	196,722
Sopishte	
Studenichani	

**Data from table are detailed explained in Annex 2 Table 5*

Also the total investment cost for collection trucks for the transportation of waste from themunicipalities to TSs estimated. The following table presents this task.

Table 6-19: Total CAPEX for collection trucks/Waste transportation from municipalities to TSs (€)

Municipality	TotalInvestment cost (€)
Butel	438,502
Gazi Baba	
Gjorche Petrov	
Karposh	
Shuto Orizari	
Saraj	545,108
Arachinovo	545,108
Ilinden	
Petrovets	
Chucher-Sandevo	312,850

**Data from table are detailed explained in Annex 2 Table 6*

Summarized results

Taking into consideration all the above, the investment cost for Variant 0 and Variant 1 is presented in the following table.

Table6-20:TotalCAPEXforcollectiontrucks/WastetransportationfrommunicipalitiestoTSs(€)

	Variant 0	Variant 1
Total investmentcost €	**6,766,582**	**5,643,496**

6.3.3.3Operation costs

Calculations for Variant 0

The total operational cost for collection trucks for the transportation of waste from the municipalities toCWMF estimated. The following table presents this task.

Table 6-21: Total OPEX for collection trucks/Waste transportation from municipalities to CWMF (€)

Municipality	Total Operational cost (€)
Aerodrom	272,903
Butel	172,403
Gazi Baba	272,174
Gjorche Petrov	202,073
Karposh	311,336
Kisela Voda	247,273
Centar	171,169
Chair	274,350
Shuto Orizari	117,519
Arachinovo	102,438
Ilinden	103,627
Petrovets	103,090
Zelenikovo	88,115
Studenichani	90,163
Sopishte	100,296
Saraj	227,329
Chucher-Sandevo	101,092

**Data from table are detailed explained in Annex 2 Table 7*

Calculations for Variant 1

The total operational cost (operational cost of facility and transportation cost) for each one of the TSs ispresented in the following table.

Table 6-22: Total OPEX per TS (€/y)

	Shuto Orizari TS	Vardarishte TS
Total Operational cost €	326,535	199,476

**Data from table are detailed explained in Annex 2 Table 3*

The following table presents the total operational cost concerning collection trucks for themunicipalities that will transfer their waste directly to CWMF.

Table 6-23: Total OPEX for collection trucks/Aerodrom, Kisela Voda, Centar, Chair, Zelenikovo, Sopishte&Studenichani (€)

Municipality	Total Operational cost (€)
Aerodrom	787,800
Kisela Voda	
Centar	
Chair	
Zelenikovo	146,011
Sopishte	
Studenichani	

**Data from table are detailed explained in Annex 2 Table 5*

Also the total operational cost for collection trucks for the transportation of waste from themunicipalities to TSs estimated. The following table presents this task.

Table 6-24: Total OPEX for collection trucks/Waste transportation from municipalities to TSs (€)

Municipality	Total Operational cost (€)
Butel	828,833
Gazi Baba	
Gjorche Petrov	
Karposh	
Shuto Orizari	
Arachinovo	150,267
Ilinden	
Petrovets	
Saraj	146,568
Chucher-Sandevo	56,269

**Data from table are detailed explained in Annex 2 Table 6*

Summarized results

Taking into consideration all the aforementioned figures, the operational cost for Variant 0 and Variant1 is presented in the following table.

Table 6-25: Total OPEX for collection trucks/Waste transportation from municipalities to TSs (€)

	Variant 0	Variant 1
Total Operational cost €	**2,957,351**	**2,641,759**

6.3.3.4 Levelized Unit Cost (LUC)

The index of Levelized Unit Cost is an index of cost-effectiveness and it is widely used in environmentalprojects. It expressed in €/t and calculated by dividing the net present value of the facility's net costflows over the reference period (including the investment and OM&A cost, net of revenues from sale ofby-products such as heat, electricity and scrap metals) by the discounted quantity of waste treated inthat same period, using a financial discount rate of 4%. This index is presented in the document "NewGuide to cost benefit analysis of investment project' which published by European Commission, onDecember 2014.

Taking into account the investment costs, operating costs the waste quantities which will be transferredto CWMF for the period 2021-2046, Levelized Unit Cost (LUC) for each Variant can be determined. Thefollowing table presents an overview of LUC results for each alternative examined variant.

Table 6-26: Levelized Unit Cost per examined Variant for Skopje region

Variants	LUC (€/t)
Variant 0 (Business as Usual, no TSs will be constructed/The waste will be transported throughcollection trucks in CWMF)	***16.7***
Variant 1 (Do something scenario, 2 TSs will be constructed and will serve the municipalities ofButel, Karposh, Gjorche Petrov, Saraj, Chucher Sandevo, Shuto Orizari, Gazi Baba, Arachinovo, Ilinden and Petrovets, while the municipalities of Aerodrom, Kisela Voda, Centar, Chair, Zelenikovo, Sopishte and Studenichani will transport their waste directly to CWMF)	***16.0***

**Data from table are detailed explained in Annex 2 Table 9 and Table 11*

6.3.4 Conclusions

From the previous paragraphs, it is clear that having TS results only to advantages and benefits to the stakeholders of the project for the following reasons:

- The waste collection vehicles do not have to travel long distances up to "Drisla" CWMF.
- There is saving on the consumption of the fuel and the cost of the waste transport via road is minimized
- The tyre wear and other components of waste collection vehicles are minimized by avoiding long trips resulting in extended service life
- There will be less traffic at CWMFsite thereby facilitating proper treatment of waste
- Less traffic in the road network since bigger volumes of waste are transferred more efficiently by dedicated mobile equipment of the TS
- More job opportunities are created for the local community
- TS locations can be used also for collection of other waste streams (i.e. WEEE, bulky, etc.)

Taking into consideration the mentioned benefits and needs of the present project such as travel

distances and times of the waste quantities, the optimal option is to have two (2) TS (in Shuto Orizari, and Gazi Baba).

6.4 Option analysis for Integrated Waste Management System (based on RWMPs outputs)

6.4.1 Introduction

The Regional Waste Management Plan should cover the minimum requirements set by the national waste management legislation for packaging and packaging waste. Also should cover a set of targets for biodegradable municipal waste (BMW) that should be diverted from landfills.

To fulfill the objectives of waste management, three main alternative waste management scenarios have been examined within RWMP for Skopje Region. All proposed waste management scenarios include some common elements like (i) green points that will be a collection point for recyclables and wood packaging fraction, (ii) separate collection of hazardous municipal waste, (iii) separate collection of construction and demolition waste, (iv) separate collection of WEEE and (v) separate collection of other special waste streams (elastic-tires). Also all proposed scenarios include separate collection of garden waste and sorting at source of recyclables or packaging waste based on each examined scenario. Finally the proposed scenarios including a collection system with the use of either 1 bin, 2 bins and 3 bins. Obviously, based on the collection system, the proposed treatment facilities (including home composting), are also differentiated. The following table presents a summary of the scenarios analyzed during the elaboration of RWMP for Skopje Region.

Table 6-27: Alternative Scenarios overview

	Scenario 1 (1 bin)	Scenario 2 (2 bins)	Scenario 3 (3 bins)
Waste Collection	One Bin collection system	Two Bin collection system Recyclable Waste Bin and Mixed Bin)	Three Bin collection system (Recyclable Waste Bin, Biowaste binand Mixed Bin)
Green Points	√	√	√
Home Composting	√	√	
Mixed Bin Treatment*	MBT with biodrying	MBT with biodrying	MBT with biodrying
Recyclable waste bin treatment*	-	MRF	MRF
Organic waste bin treatment*	-	-	Aerobic Composting
Green waste treatment*	Aerobic Composting	Aerobic Composting	Aerobic Composting
Landfill	√	√	√

(*) According the PPP contract

For all the aforementioned scenarios flow diagrams have been created, the targets according Law on management of packaging and packaging waste and according LoWM Article 8 for biodegradable municipal waste landfilled have been quantified and financial-economic analysis has been implemented.

6.4.1.1 Overview of proposed scenarios

Scenario 1: One Bin collection system (Mixed Waste Bin)

Scenario1 is basedinonebincollectionsystem(mixedwaste).Thekeyfeaturesofscenario1 are:

Collection

- *OneBinCollectionsystemformixedwaste*.According tocalculations, thetotalnumberofwastebins (capacity1.1m^3)thatneeded forscenario1is4,189.However becausetherearealreadyexistingbins withthiscapacityinSkopjeRegion,thenecessarybinsthatneededtobepurchasedinscenario1are 491.Theamountofwastecollectedinthisscenariois155,398t/y(83.24%oftotalgeneratedwaste).
- *SeparateCollectionofHazardousmaterial/WEEE/C&Dmaterial/RecyclingMaterial/Wood/OtherSpecial WasteStreams*.Thefollowingassumptionshavebeenmade:(i)Collectionof100%ofelectric andelectronicwastefractioni.e.0.20%oftotalgeneratedwaste(381t/y),(ii)Collectionof100%of municipalhazardouswastefractioni.e.0.24 %oftotalgeneratedwaste(443 t/y),(iii)Collectionof30% ofconstructionanddemolitionwastefraction,i.e.0.86%oftotalgeneratedwaste(1603t/y)and(iv) Collection of15%ofwoodfraction,i.e.0.08%oftotalgeneratedwaste(144t/y),(i)Collectionof50% of otherspecialwastestreamsfraction,i.e.0.25% oftotalgeneratedwaste(472t/y)and (vi)Collection of3%ofrecyclablematerialsinGreenPoints,i.e.1.1%oftotalgeneratedrecyclablewaste(2057t/y).
- *SeparatecollectionofGreenWaste.*Theassumptionmadeisthatthe40%ofgreenwastefraction collected,i.e.5.63%oftotalgeneratedwaste(10,512t/y).
- *SortingatSourceforpackagingwaste(CollectiveSchemes)*.Theminimumrequirementsthatneedtobeachi evedinyear2021are:glasspackaging50.0%,plastic packaging11%,paperpackaging38.6%,Fe packaging33.6%andAlpackaging33.6%(allofthesepercentages areofgeneratedpackagingwaste fraction).Thetotalpercentageofcollected packaging wastein2021forscenario 1aftercalculations,is 24.62%oftotalgeneratedpackagingwasteand7.43%oftotalgeneratedwaste(13,868t/y).

TreatmentofMixedWasteBin

- CollectedMixedWastefromthemixedBinprocessedtoaMechanical BiologicalTreatmentPlantwith biodryingprocess.

TreatmentofBiodegradablessortedatsource(HomeComposting)

- *HomeComposting*. Fortheestimationofquantitiesthatwillbedirectedtohomecompostingprocess, itisassumedthatthe20%ofruralpopulationwillbeserved,i.e.20%*11.5%=2.3%, andthefractions that can be used in thisprocess aregreen waste,biodegradablewaste andwood. Accordingto calculations,thetotalnumberofwastebinsthatneededforscenario1andhomecompostingprocess is3,992.

TreatmentofGreenWaste

- Collected Green Waste will be directed to windrow composting process for the production of high quality compost.

Table6-28:Assumptionsandcalculationsforscenario1

		%Collection(Average 2021-2046)
GreenPoints	A* A A C	3% of recyclable materials fraction 15% ofwood packaging fraction 3.2% ofpackagingwastefraction Total collection:0.97% ofgeneratedwaste
Sorting at source of packaging waste (Collective Schemes)	A C	24.62% of packagingwaste 7.43% ofgeneratedwaste
GreenWaste	A C	40% ofgreenwaste fraction 5.63% ofgeneratedwaste
Home Composting	A C	Servedthe20% of ruralpopulation, 2.3% of total population 2.3% ofGreenwaste +Biodegredable waste 0.97% ofgeneratedwaste
SeparateCollectionof other wastefractions	A A A C	50% ofWEEE fraction 50% ofC&Dmaterial fraction 50% ofother special waste streams fraction 1.3%ofgeneratedwaste
Hazardous materials	A C	100% ofHazardous material fraction 0.24% ofgeneratedwaste
Packaging waste Mechanical Treatment	A C	2.83% ofpackaging waste 0.85% of generated waste

A: Assumption,C: Calculation

In order to determinethe recyclable quantities and packaging materials collected from mechanical separationofMBSPlantthefollowingassumptionsweremade:

Recyclables	**Incomingquantities ofrecyclablesin Mechanicaltreatment % (ofgenerated waste)**	**Final Recovery%**	**Recoveryof packaging fraction***
Fe	0.78%	0.66%	0.46%
Al	0.46%	0.39%	0.39%
Total	**1.24%**	**1.05%**	**0.85%**

**Femetal packaging = 70% of total Femetal fraction*
**Al metal packaging = 100% of total Al fraction*

Inthefollowingtables,theachievementofnationaltargetsforrecyclingandbiodegradablewastefor landfillingispresented.

Packagingwaste

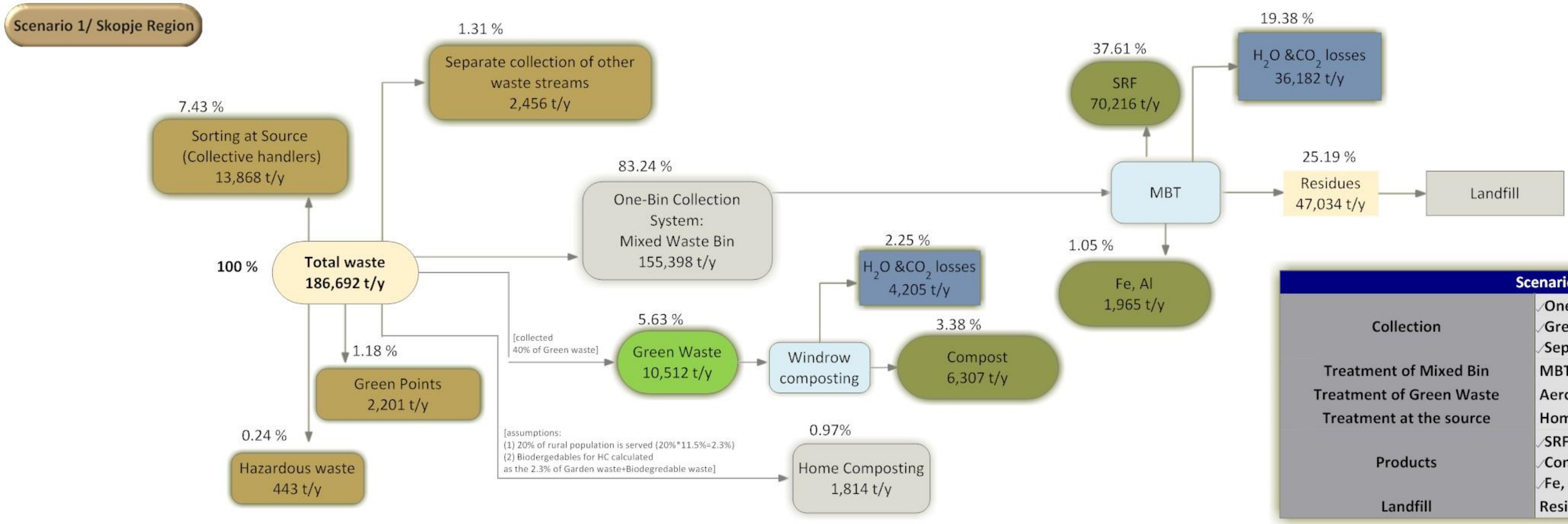
Recycling ofpackaging waste % (2021)	Scenario 1	Achievement on recyclingtargets
Total % of recycling of packaging waste	55.06%	Yes
% glass packaging	62.40%	Yes
% plastic packaging	48.40%	Yes
% paperpackaging	60.29%	Yes
% Fe packaging	90.49%	Yes
% Al packaging	90.49%	Yes
% woodpackaging	15.00%	Yes

Biodegradablewaste

Reduction of BMW	Scenario 1	Achievement BMW on targets of BDW
Reductionof quantity of BMW landfilled, expressedas a percentage reduction ofthe BMWgeneratedin 1995 (2021)*	77.28 %	Yes
Reductionof quantity of BMW landfilled, expressedas a percentage reduction ofthe BMWgeneratedin 1995 (2027)	77.20%	Yes

**Biodegradablemunicipal wastein territory 1995=305000 t (Rulebook LoWM Article87) Total populationof country 2,022,547 (statisticaloffice2002)*
Skopje Region Population578,144 (28.58% of territory)
*Biodegradablemunicipal wastein Skopje Region 1995, 28.58%*305,000 t =87,184 t*

Detailed flow diagram for Scenario 1



Scenario 1	
Collection	One Bin Collection System Green Points Separate Collection of Green waste
Treatment of Mixed Bin	MBT with biodrying
Treatment of Green Waste	Aerobic Composting
Treatment at the source	Home Composting
Products	SRF Compost Fe, Al
Landfill	Residues from treatment

Scenario2: Two bincollectionsystem(MixedWaste & Recyclable Waste)

Scenario2isbasedintwobincollectionsystem(mixedwasteandrecyclablewaste).Thekeyfeaturesof scenario2are:

Collection

- *TwoBinCollectionsystem*.One*recyclablewastebin* for separatecollectionofrecyclablesatsourceand one*MixedBin*forresidualwaste.Accordingtocalculations, thetotalnumberofmixedwastebins (capacity1.1m^3)thatneeded forscenario 2is3,305andthetotalnumberofrecyclable wastebins (capacity1.1m^3) is4,786.However,becausethereare alreadyexistingbins for residualwasteinSkopje Region,thenecessarymixedwastebinsthatneededtobepurchasedinScenario2are553.The amountofwastecollectedinmixedwastebinis122,602t/y(65.67%oftotalgeneratedwaste)andthe amountofwastecollectedinrecyclablewastebinis46,664t/y(24,99%oftotalgeneratedwaste).
- *SeparateCollectionofHazardousmaterial/WEEE/C&Dmaterial/RecyclingMaterial/Wood/OtherSpecial WasteStreams*.Thefollowingassumptions havebeenmade:(i)Collection of100%ofelectric andelectronicwastefractioni.e.0.20%oftotalgenerated waste(381t/y),(ii)Collectionof100%of municipalhazardouswastefractioni.e.0.24 %oftotalgeneratedwaste(443 t/y),(iii)Collectionof30% ofconstruction anddemolitionwastefraction,i.e.0.86%oftotalgeneratedwaste(1603t/y)and(iv) Collection of15%ofwoodfraction,i.e.0.08%oftotalgeneratedwaste(144t/y),(i)Collectionof50% of otherspecialwastestreamsfraction,i.e.0.25% oftotalgeneratedwaste(472t/y)and (vi)Collection of3%ofrecyclablematerialsinGreenPoints,i.e.1.1%oftotalgeneratedrecyclablewaste(2057t/y).
- *SeparatecollectionofGreenWaste.*Theassumptionmadeisthatthe40%ofgreenwastefraction collected,i.e.5.63%oftotalgeneratedwaste(10,512t/y).
- *SortingatSourceforpackagingwaste(CollectiveSchemes)*.Theminimumrequirementsthatneedtobeachi evedinyear2021are:glasspackaging50.0%,plastic packaging11%,paperpackaging38.6%,Fe packaging33.6%andAlpackaging33.6%(allofthesepercentages areofgeneratedpackagingwaste fraction).Thetotalpercentageofcollected packaging wastein2021forscenario 1aftercalculations,is 24.62%oftotalgeneratedpackagingwasteand7.43%oftotalgeneratedwaste(13,868t/y).
- *SortingatSourceforrecyclablewaste*.Therecyclableswhichwillbeinsertedinrecyclablebinshould be:glasspackaging4.42%,plasticpackaging 17.34%,paperpackaging 14.86%,Fepackaging1.03%and Alpackaging0.71%(allofthesepercentagesareoftotalgeneratedwaste).

TreatmentofMixedWasteBin

- CollectedMixedWastefromthemixedBinprocessedtoaMechanicalBiologicalTreatmentPlantwith biodryingprocess.

TreatmentofGreenWaste

- CollectedGreenWastewillbedirectedtowindrowcompostingprocessfortheproductionofhigh qualitycompost.

Table6-29:Assumptionsandcalculationsforscenario2

		%Collection(Average 2021- 2046)
GreenPoints	A* A A C	3% of recyclable materials fraction 15% ofwood packaging fraction 3.2% ofpackagingwastefraction Total collection:0.97% ofgeneratedwaste
GreenWaste	A C	40% ofgreenwaste fraction 5.63% ofgeneratedwaste
Home Composting	A C	Servedthe20% of ruralpopulation, 2.3% of total population 2.3% ofGreenwaste +Biodegredable waste 0.97% ofgeneratedwaste
SeparateCollectionof other wastefractions	A A A C	50% ofWEEE fraction 50% ofC&Dmaterial fraction 50% ofother special waste streams fraction 1.3%ofgeneratedwaste
Hazardous materials	A C	100% ofHazardous material fraction 0.24% ofgeneratedwaste
Packaging waste MRF/MBT	A C	51.88% ofpackagingwaste 15.68% ofgenerated waste

*A: Assumption,C: Calculation

Inordertodeterminetherecyclablequantitiesandpackagingmaterialscollectedfromthemechanical separationofMRF(scenario2)thefollowingassumptionsweremade:

Recyclables	Incoming quantities of recyclables in Mechanical treatment % (of generated waste)	Final Recovery%	Recoveryof packaging fraction*
Paper	14.86%	9.16%	5.64%
Plastic	17.34%	8.50%	7.42%
Glass	4.42%	2.73%	1.91%
Fe	1.03%	0.51%	0.36%
Al	0.71%	0.35%	0.35%
Total	**38.35%**	**21.25%**	**15.08%**

*Paper packaging = 61.58% of total paper fraction
*Plastic packaging = 87.34% of total plastic fraction
*Glasspackaging = 70.00% of total glass fraction
*Femetal packaging = 70.00% of total Femetal fraction
*Al metal packaging = 100% of total Al fraction

Inthefollowingtables,theachievementofnationaltargetsforrecyclingandbiodegradablewastefor landfillingispresented.

Packagingwaste

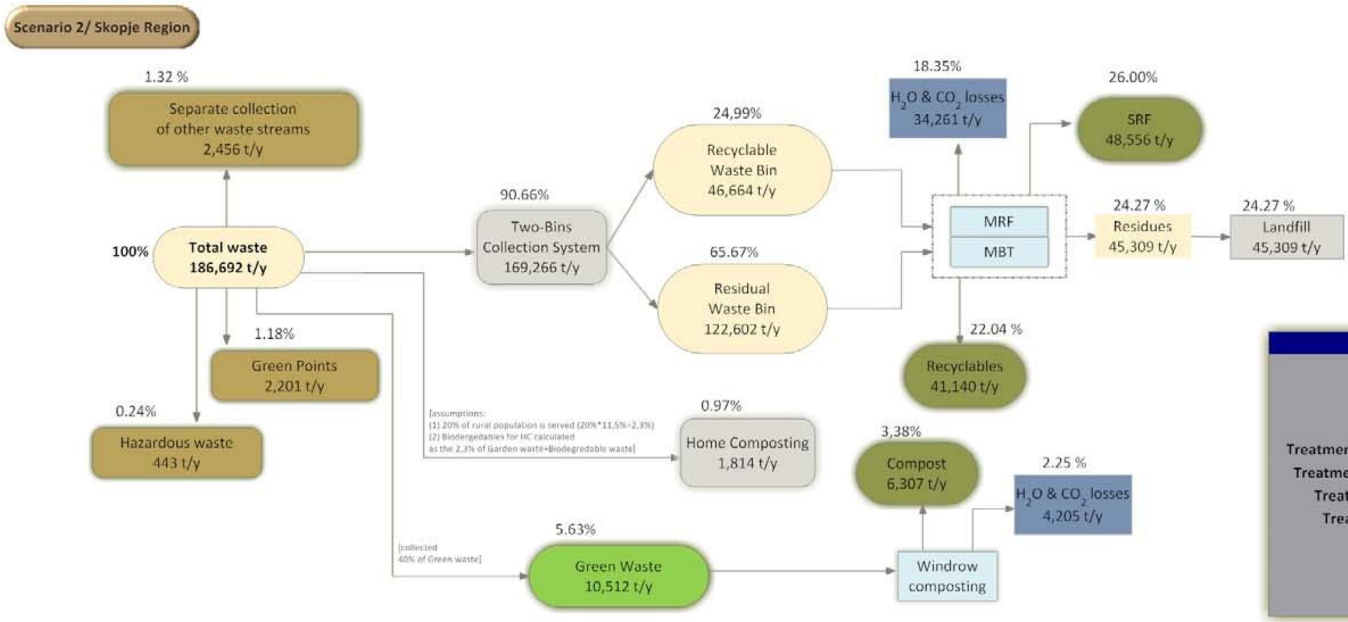
Recycling ofpackaging waste % (2021)	Scenario 2	Achievement on recyclingtargets
Total % of recycling of packaging waste	55.08%	Yes
% glass packaging	62.78%	Yes
% plastic packaging	50.53%	Yes
% paperpackaging	62.78%	Yes
% Fe packaging	51.50%	Yes
% Al packaging	51.50%	Yes
% woodpackaging	15.00%	Yes

Biodegradablewaste

Reduction of BMW	Scenario 2	Achievement BMW on targets of BDW
Reductionof quantity of BMW landfilled, expressedas a percentage reduction ofthe BMWgeneratedin 1995 (2021)*	77.28 %	Yes
Reductionof quantity of BMW landfilled, expressedas a percentage reduction ofthe BMWgeneratedin 1995 (2027)	77.20%	Yes

**Biodegradablemunicipal wastein territory 1995=305000 t (Rulebook LoWMArticle87) Total populationof country 2,022,547 (statisticaloffice2002)*
Skopje Region Population578,144 (28.58% of territory)
*Biodegradablemunicipal wastein Skopje Region 1995, 28.58%*305,000 t =87,184 t*

Detailed flow diagram for Scenario 2



Scenario 2	
Collection	Two Bins Collection System (Recyclable Waste Bin and Residual Waste Bin) Green Points Separate Collection of Green waste
Treatment of Recyclable Waste Bin	MRF
Treatment of Residual Waste Bin	MBT with biodrying
Treatment of Green Waste	Aerobic composting
Treatment at the Source	Home Composting
Products	Compost Recyclables
Landfill	Residues from MRF Facility and Biostabilization Process

Scenario 3: Three bin collection system(Mixed Waste, Recyclable Waste & Biodegradable waste)

Scenario3is basedinthreebincollectionsystem(mixedwaste,biodegradablewasteandrecyclable waste).Thekeyfeaturesofscenario3are:

Collection

- *ThreeBinCollectionsystem*.One*organicwastebin*forseparatecollectionofbiowasteatsource,one *Recyclable wasteBin*forseparatecollectionofrecyclables atsourceandone*MixedBin*forresidual waste.Accordingtocalculations,thetotalnumber ofresidual wastebins(capacity1.1m^3)thatneeded forscenario 3is2,104,thetotalnumber oforganic wastebins(capacity 0.66m^3)is6.540andthetotal numberofrecyclablewastebins,capacity1.1m^3 4,786.However,becausetherearealreadyexisting residual waste bins in Skopje Region,thenecessary residual/mixed waste bins that need tobe purchased inscenario3are219.Theamount ofwastecollectedinresidualwastebinis78,040t/y (41.80%oftotalgenerated waste),theamountofwastecollectedinorganicwastebinis46,376t/y (24.84%oftotalgeneratedwaste)andtheamountofwastecollectedinrecyclable wastebinis46,664 t/y(24.99%oftotalgeneratedwaste).
- *SeparateCollectionofHazardousmaterial/WEEE/C&Dmaterial/RecyclingMaterial/Wood/Other SpecialWasteStreams*.Thefollowingassumptions havebeenmade:(i)Collection of100%ofelectric andelectronicwastefractioni.e.0.20%oftotalgenerated waste(381t/y),(ii)Collectionof100%of municipalhazardouswastefractioni.e.0.24 %oftotalgeneratedwaste(443 t/y),(iii)Collectionof30% ofconstruction anddemolitionwastefraction,i.e.0.86%oftotalgeneratedwaste(1603t/y)and(iv) Collection of15%ofwoodfraction,i.e.0.08%oftotalgeneratedwaste(144t/y),(i)Collectionof50% of otherspecialwastestreamsfraction,i.e.0.25% oftotalgeneratedwaste(472t/y)and (vi)Collection of3%ofrecyclablematerialsinGreenPoints,i.e.1.1%oftotalgeneratedrecyclablewaste(2057t/y).

- *SeparatecollectionofGreenWaste.*Theassumptionmadeisthatthe40%ofgreenwastefraction collected,i.e.5.63%oftotalgeneratedwaste(10,512t/y).
- *SortingatSourceforrecyclablewaste*.Therecyclableswhichwillbeinsertedinrecyclablebinshould be:glasspackaging4,20%,plasticpackaging6,44%,paperpackaging10,37%,Fepackaging0,75%andAl packaging0,50%(allofthesepercentagesareoftotalgeneratedwaste).
- *SortingatSourceforbiodegradablewaste(Organicwastebin)*. The minimum requirementsthat neededtobeachievedinyear2021and2027are:20%and74%respectivelyofbiodegradable waste and20%and85%respectivelyforgardenwaste.

TreatmentofMixedWasteBin

- CollectedMixedWastefromthemixedBinprocessedtoaMechanicalBiologicalTreatmentPlantwith biodryingprocess.

TreatmentofBiodegradablessortedatsource(OrganicWasteBin)

Biologicaltreatment(aerobiccomposting).Theproducedcompostcanbesoldasgoodqualitycompost.

TreatmentofRecyclableWasteBin

CollectedRecyclableWastefromtheRecyclablewaste binwillbetreatedinaMRFPlant.Materialswillbesold.Resideswillbedisposedinlandfill.

TreatmentofGreenWaste

- CollectedGreenWastewillbedivertedtoaerobiccompostingprocessfortheproductionofhigh qualitycomposttogetherwiththewastefromtheOrganicBin.

Table6-30:Assumptionsandcalculationsforscenario3

		%Collection(Average 2021- 2046)
GreenPoints	A* A A C	3% of recyclable materials fraction 15% ofwood packaging fraction 3.2% ofpackagingwastefraction Total collection:0.97% ofgeneratedwaste
Sorting at source ofpackagingwaste (Collective Schemes)	A C	24.62% packaging waste 7.43% ofgeneratedwaste
GreenWaste	A C	40% ofgreenwaste fraction 5.63% ofgeneratedwaste
Home Composting	A C	Servedthe20% of ruralpopulation, 2.3% of total population 2.3% ofGreenwaste +Biodegredable waste 0.97% ofgeneratedwaste
SeparateCollectionof other wastefractions	A A A C	50% ofWEEE fraction 50% ofC&Dmaterial fraction 50% ofother special waste streams fraction 1.3%ofgeneratedwaste
Hazardous materials	A C	100% ofHazardous material fraction 0.24% ofgeneratedwaste
Organic wastebin (sortingat source ofbiodegradablewaste)		65.70% ofbiodegradable waste fraction And 44.91ofgreenwaste fraction 24.84% oftotal generated waste
Packaging waste MRF/MBT	A C	51.88% ofpackagingwaste 15.68% ofgenerated waste

A: Assumption, C: Calculation

Fordetermineofrecyclablequantitiesandpackagingmaterialsthatcollectedfrommechanicalseparation ofMRF(scenario3)thefollowingassumptionsweremade:

Recyclables	Incoming quantities of recyclables in Mechanical treatment % (of generated waste)	Final Recovery%	Recoveryof packaging fraction*
Paper	14.86%	9.16%	5.64%
Plastic	17.34%	8.50%	7.42%
Glass	4.42%	2.73%	1.91%
Fe	1.03%	0.51%	0.36%
Al	0.71%	0.35%	0.35%
Total	**38.35%**	**21.25%**	**15.08%**

**Paper packaging = 61.58% of total paper fraction*
**Plastic packaging = 87.34% of total plastic fraction*
**Glasspackaging = 70.00% of total glass fraction*
**Femetal packaging = 70.00% of total Femetal fraction*
**Al metal packaging = 100% of total Al fraction*

Inthefollowingtables,theachievementofnationaltargetsforrecyclingandbiodegradablewastefor landfillingispresented.

Packagingwaste

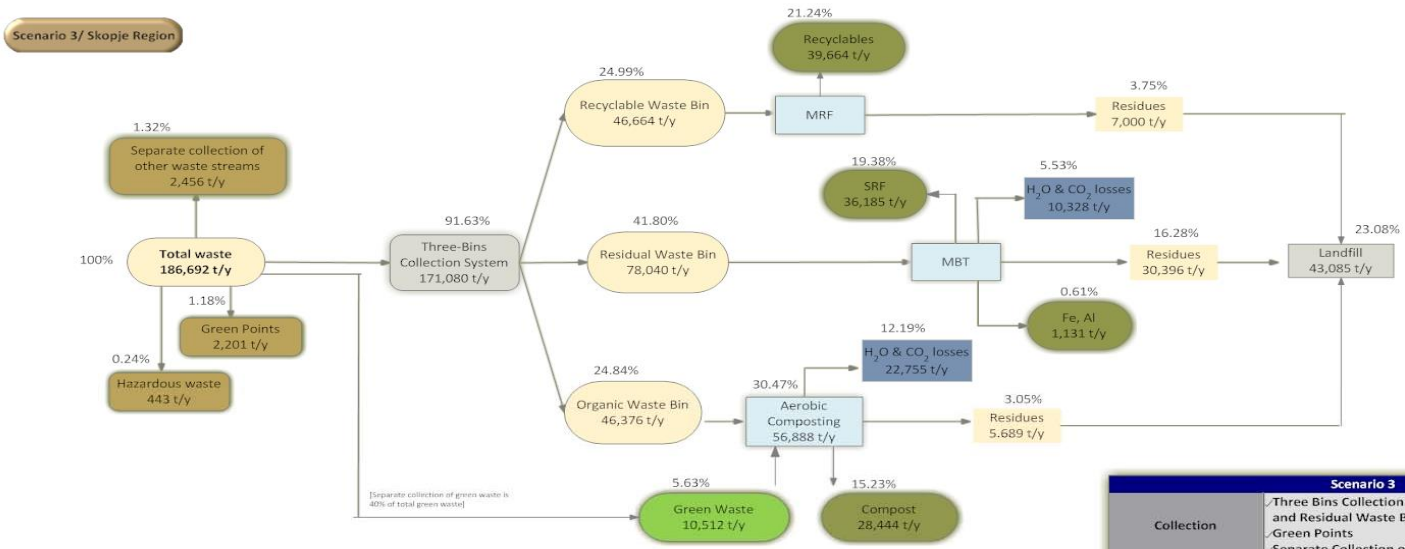
Recycling ofpackaging waste % (2021)	Scenario 3	Achievement on recyclingtargets
Total % of recycling of packaging waste	55.08%	Yes
% glass packaging	62.78%	Yes
% plastic packaging	50.53%	Yes
% paperpackaging	62.78%	Yes
% Fe packaging	51.50%	Yes
% Al packaging	51.50%	Yes
% woodpackaging	15.00%	Yes

Biodegradablewaste

Reduction of BMW	Scenario 3	Achievement BMW on targets of BDW
Reductionof quantity of BMW landfilled, expressedas a percentage reduction ofthe BMWgeneratedin 1995 (2021)*	88.36 %	Yes
Reductionof quantity of BMW landfilled, expressedas a percentage reduction ofthe BMWgeneratedin 1995 (2027)	88.014%	Yes

*Biodegradablemunicipal wastein territory 1995=305000 t (Rulebook LoWMArticle87) Total populationof country 2,022,547 (statisticaloffice2002)
Skopje Region Population578,144 (28.58% of territory)
*Biodegradablemunicipal wastein Skopje Region 1995, 28.58%*305,000 t =87,184 t*

Detailed flow diagram for Scenario 3



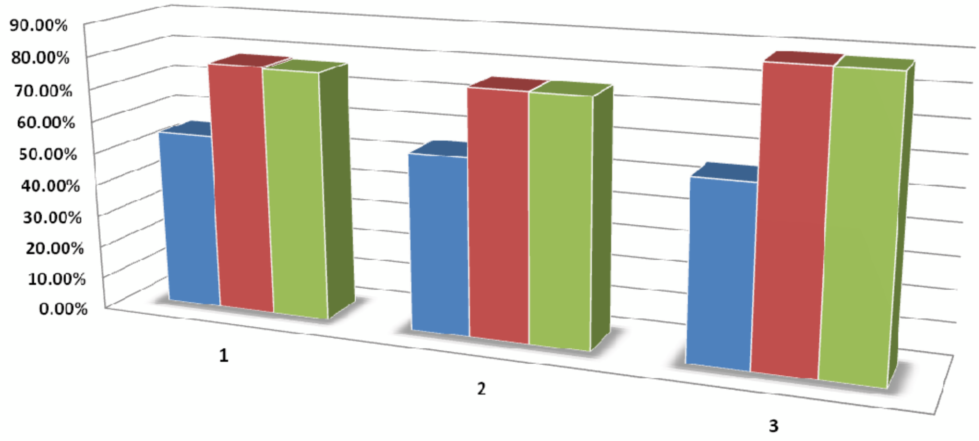
Scenario 3	
Collection	✓Three Bins Collection System (Recyclable Waste Bin and Residual Waste Bin and Organic Waste Bin) ✓Green Points ✓Separate Collection of Green waste
Treatment of Recyclable Waste Bin	MRF
Treatment of Residual Waste Bin	MBT with biodrying
Treatment of Organic Waste Bin	Aerobic Composting
Treatment of Green Waste	Aerobic Composting
Products	✓Compost ✓Recyclables
Landfill	Residues from MRF Facility, Aerobic Composting and MBS

Asit is aforementionedthediscussedscenariosmustachievetheminimumrequirementsbasedonnational legislationaccordingtotheLawonmanagement ofpackagingandpackagingwasteandtotheLawin relationtoreductionofthequantity ofBiodegradablemunicipalwaste landfilled.Thetablebelowpresents thequantificationoftargetsforallscenariosinSkopjeRegion.

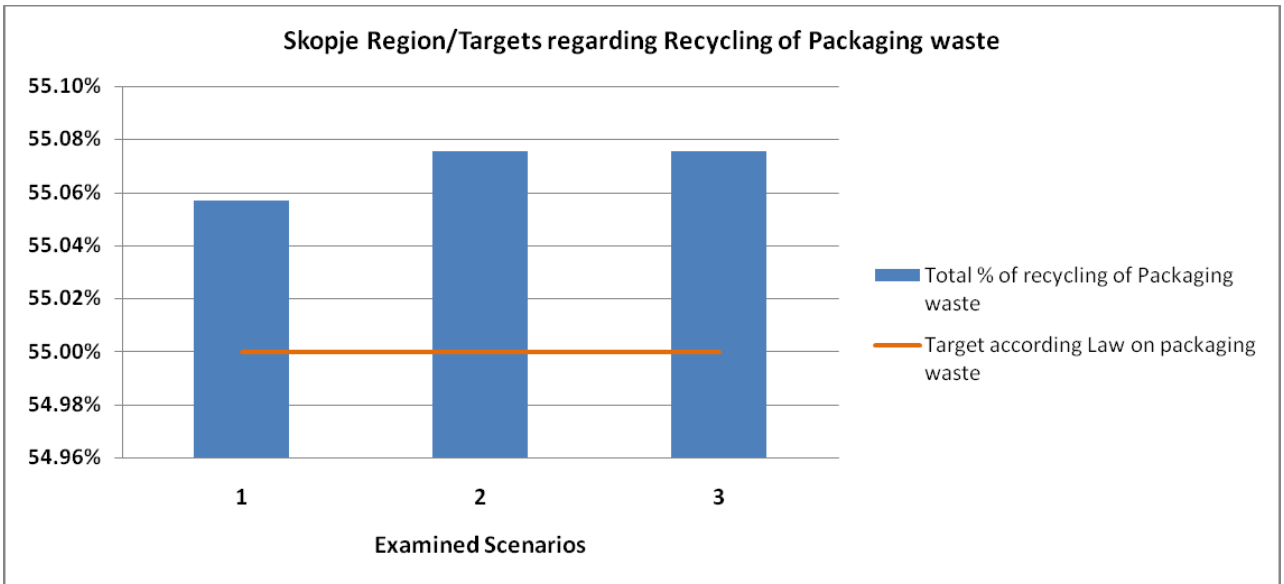
Table6-31:QuantificationoftargetsforallscenariosinSkopjeRegion

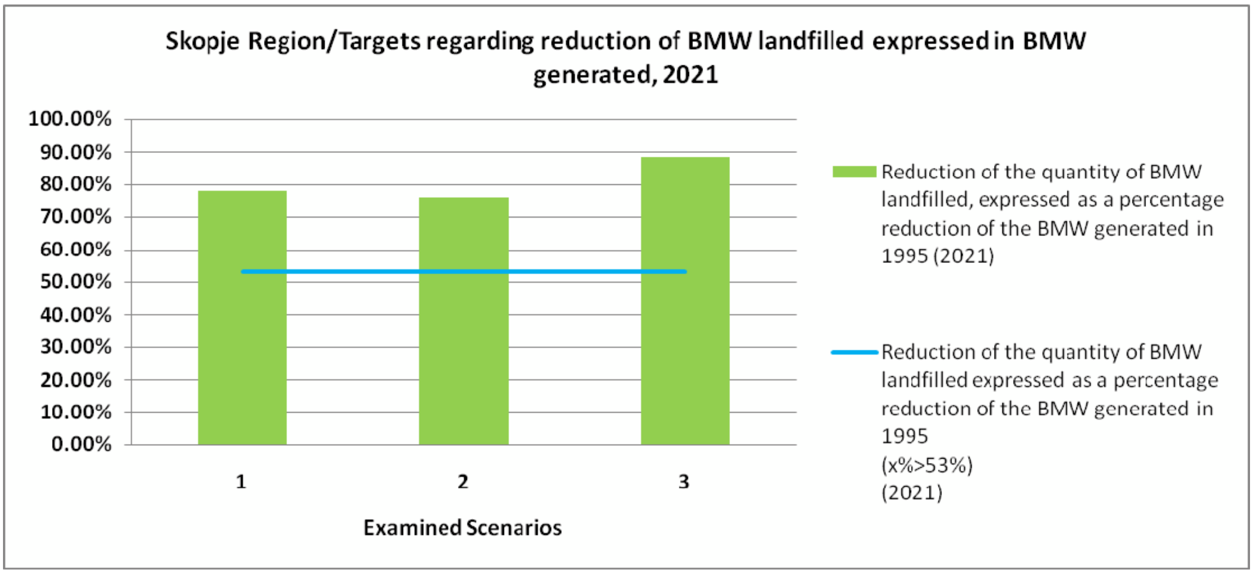
Scenarios	Totalpercentageofrecyclingof packaging waste (2021)		Reduction ofthequantityofBMW landfilled, expressedas a percentagereductionoftheBMW generated in 1995	
			2021	2027
1	55.06%	Glass 62.40%	77,82%	77.20%
		Plastic48.40%		
		Paper 60.29%		
		Fe 90.49%		
		Al 90.49%		
		Wood 15.00%		
2	55.08%	Glass 62.78%	75.91%	75.76%
		Plastic50.53%		
		Paper 62.78%		
		Fe 51.50%		
		Al 51.50%		
		Wood 15.00%		
3	55.08%	Glass 62.78%	88.36%	88.04%
		Plastic50.53%		
		Paper 62.78%		
		Fe 51.50%		
		Al 51.50%		
		Wood 15.00%		

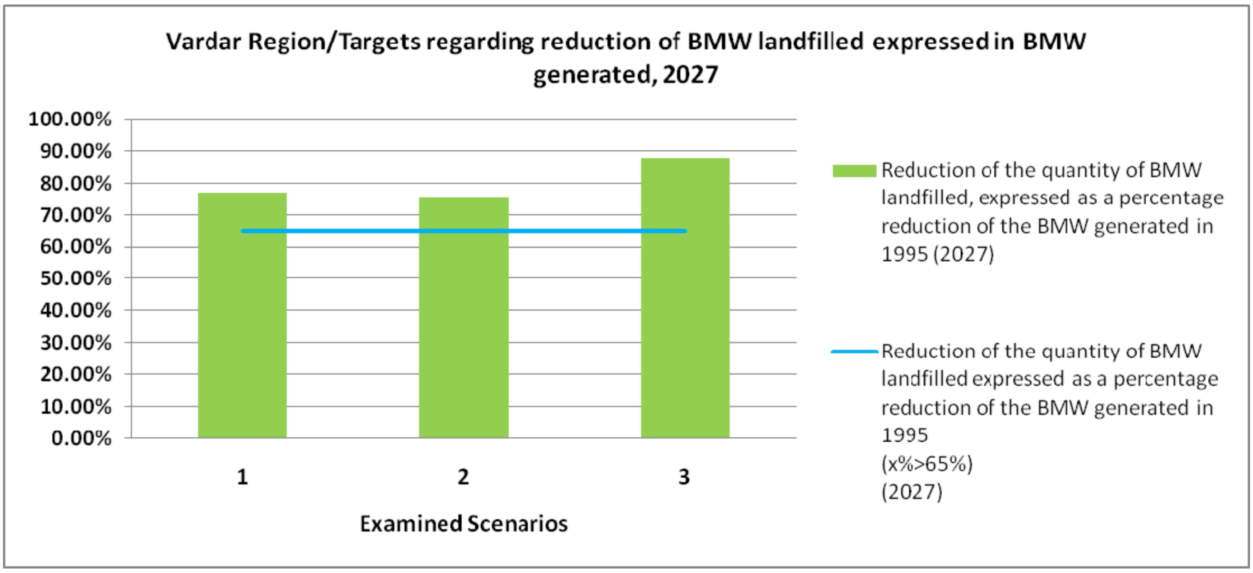
Allthescenariosachievethetargets.



	1	2	3
Total % of recycling of Packaging waste	55.06%	55.08%	55.08%
Reduction of the quantity of BMW landfilled, expressed as a percentage reduction of the BMW generated in 1995 (2021)	77.82%	75.91%	88.36%
Reduction of the quantity of BMW landfilled, expressed as a percentage reduction of the BMW generated in 1995 (2027)	77.20%	75.76%	88.04%







The proposed scenario for the Waste Management System in Skopje Region is Scenario 2. According to this scenario, the waste management system includes:

- Separate collection of recyclable materials and wood packaging fraction in green points,
- Separate collection of hazardous materials in municipal waste
- Separate collection of other waste fraction, i.e. other special waste streams (elastic-tyres), WEEE and construction and demolition waste.
- Home composting actions,
- Separate collection of green waste which will be diverted to windrow composting process for the production of high quality compost.
- Recyclable waste bin which will be diverted to a Material Recovery Facility (MRF) for the recovery

of recyclables (glass, paper, plastic, metals)

- Residual waste bin which will be diverted to a Mechanical Biological treatment plant (MBT) with biostabilizarion. Recyclables and SRF will be recovered from mechanical treatment of residual waste bin.
- Landfill which will accept residues.

6.4.2 Project justification against scenarios Business as Usual and Do minimum

After the selection of the appropriate waste management system in Skopje region (Scenario 2) the alternatives which will be examined in this paragraph are:

Option 1-Business as Usual (BaU): Collection through collection trucks and disposal at “Drisla” landfill. Continuation of the current situation concerning recycling.

Option 2-Do minimum: Collection and disposal of waste through Transfer stations and/or collection trucks, continuation of the current situation concerning recycling.

Option 3-Do something: Collection and disposal of waste through proposed Transfer stations and/or collection trucks, change waste management treatment options according to selected Scenario 2 from RWMP

Option 1-Business as Usual

The following diagram presents the Business as Usual option for Skopje region.

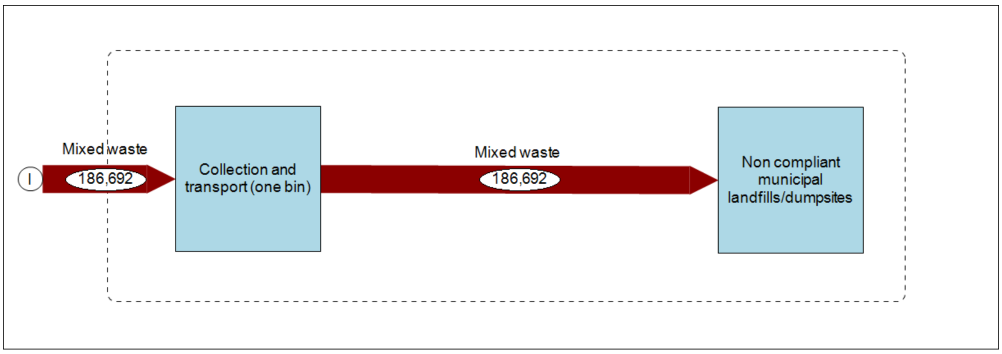


Figure6-15: Business as Usual Option

Option 2-Do minimum

The following diagram presents the Do mimimum option for Skopje region.

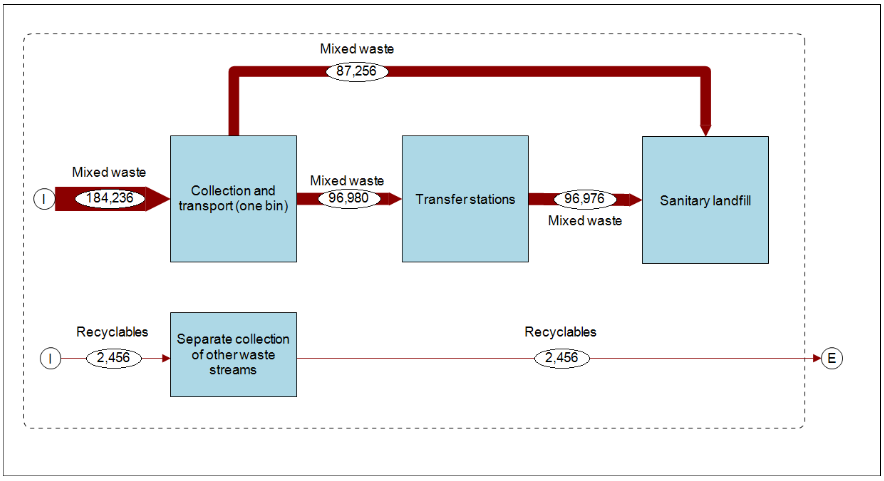


Figure6-16: Option Do minimum

Option 3-Do something

The following diagram presents the Do something option for Skopje region.

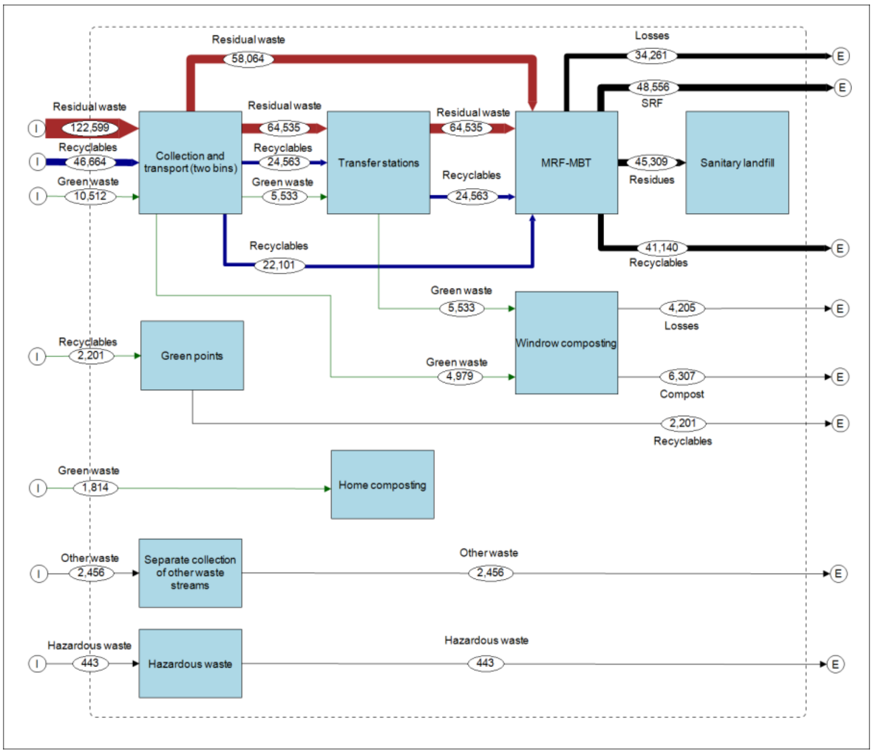


Figure6-17: Do somethingoption/Selected Scenario 2

7. PROPOSED INVESTMENT PROJECT

7.1 Conceptual Design

7.1.1 Storage facilities

Dry recyclables and mixed waste streams within municipal waste account for 24.99% and 65.67% respectively. The remaining 9.34% regards diversion of waste through other means such as home composting or through collection in Green Points (green waste, etc.).For waste temporary storage in the so-called "Bring system", the wheeled standard Euro-bin 1,1 m³ will be adopted. These bins offer reduced supply cost and reduced collection cost (minimizing travel & unloading time, route complexity and environmental impacts) compared to the other smaller standard sizes associated with the "Door-to-door system" (bins are moved from each household and collected on a specific day of the week).For dry recyclables, it offers less space needed in homes and less sorting effort by residents. For the development of the two bin collection system in the project area according to the identified needs, a suitable number of bins have been determined.

Table 7-1: Current Collection bin equipment for mixed waste and the collection frequency (per week) per municipality

Household premises	5 m^3				1.1 m^3				240 lt				120 lt			
	metal	plastic	others	frequency	metal	plastic	others	frequency	metal	plastic	others	frequency	metal	plastic	others	frequency
Aerodrom	31				786			6						5849		2
Arachinovo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chucher-Sandevo	20			1	107			1		120						1
City of Skopje	412				2952	1915		6						77344	1923	2
Gazi Baba	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gjorce Petrov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ilinden	60				228					380				4398		1
Karposh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kisela Voda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Butel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cair	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Centar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petrovec					80			1		460		1		970		1
Saraj	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shuto Orizari	5				30			6						7478		2
Sopiste					16			2						5200		5
Studenicani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zelenikovo					73	7		1			107	1		120		1

The two bin collection system concerns:

- Residual waste bin which will be diverted to a Mechanical Biological treatment plant (MBT) with biostabilization.
- Recyclable waste bin which will be diverted to a Material Recovery Facility (MRF) for the recovery of recyclables (glass, paper, plastic, metals)

This is the collection system of the proposed scenario (Sc 2) for Skopje Region.The information for existing bins was taken from the waste questionnaires and was presented in the Assessment Report of the region and in the following tables.

Table 7-2: Current Collection bin equipment for recyclable waste per municipality

Household premises	1.1 m^3					240 lt					120 lt				
	Glass	Paper/Cardboard	Plastic	Metals	Combined	Glass	Paper/Cardboard	Plastic	Metals	Combined	Glass	Paper/Cardboard	Plastic	Metals	Combined
Aerodrom	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arachinovo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Chucher-Sandevo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
City of Skopje	-	-	21	-	-	19	19	19	-	-	-	-	-	-	-
Gazi Baba	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gjorce Petrov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ilinden	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Karposh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kisela Voda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Butel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cair	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Centar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petrovec	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saraj	2	15	4	-	-	-	-	-	-	-	-	-	-	-	-
Shuto Orizari	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sopiste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Studenicani	-	-	-	-	-	-	140	-	-	-	-	-	-	-	-
Zelenikovo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Metal bins are usually applied to prevent major damage when hot ash or other burning objects are deposited. On the other hand, this constraint does not exist for dry recyclables and lightweight HDPE plastic bins are preferred.It has been decided to mainly adopt 1.1 m^3 metal bins for mixed waste in settlements with population more than 500 residents. This size was chosen for financial reasons compared to the smaller bins of 120/240 lt, as it will induce savings to the municipalities.

The bins will be distributed on the streets at a distance of maximum 50m.On the other hand, in rural settlements with population less than 500 residents, 120 lt plastic bins have been selected (one bin per household) for reasons of convenience. The number is not too excessive and it will not significantly increase the budget of the supply tender.

For recyclables, 1.1 m^3 plastic bins will be adopted for both urban and rural areas ("Bring system"). Other size bins, especially 5m^3 that are cumbersome and considered as outdated, will not be used.

The existing bins as well as their current age were taken from the waste questionnaires and from the oral communication with the municipalities. In case the age of the containers was unknown, it was decided to replace 50% of the given number.

Furthermore, the following assumptions are adopted:

- Waste composition, generation and projections are according to the previous chapters.
- The density of recyclables and MW is about 120 and 180 kg/m^3, respectively
- Filling degree of bins and containers is 85% based on our experience from previous projects.
- Collection frequency for mixed waste will be about 2 and 1 times per week in urban and rural areas respectively.
- Collection frequency for recyclables will be about 2 and 1 times per month in urban and rural areas respectively.

Calculations were made per settlement and afterwards summarized on municipal level in Skopje Region (Annex III). For this purpose, data from the State Statistical Office (sixth edition of "Regions of the Republic of Macedonia, 2016" population) was taken. The number of bins needed for the proposed waste collection system was calculated adopting the following assumptions:

- In settlements with population ≤ 300 only mixed waste, not dry recyclables, bins will be allocated, as it is not economically justifiable (thus citizens will drop all material to one bin).
- In areas with population ≥ 3,000 bins will be allocated for commercial &industrial non- hazardous municipal waste. This source accounts for 19% of municipal solid waste.

The needs for home composting bins have been calculated at the level of each rural settlement in all municipalities in Skopje Region. For home composting, plastic bins were chosen. The 20% of households in rural areas will be provided with a home composting bin. Specifically, one home composting bin per household. According to calculations for the number of persons per household for each municipality, the number of home composting bins needed was calculated.

Calculations for waste storage bins per municipality are presented in the following tables, where figures are rounded to the upper decade.

Table 7-3: Results of calculations for mixed waste bins in Skopje Region

Municipality	Number of 1.1 m^3 bins (commerce & industry)	Number of 1.1 m^3bins (houses)	Number of 120 lt bins (households)	1.1 m^3 bins in place	120 lt bins in place	1.1 m^3bins to be purchased	120 lt bins to be purchased
Aerodrom	173	776	0				
Butel	88	386	0				
Gazi Baba	156	791	345				
Karposh	135	611	118				
Kisela Voda	140	595	118				
Chair	160	680	0				
Centar	115	488	0				
Gjorche Petrov	92	432	65				
Shuto Orizari	53	234	0				
*City of Skopje**	*1,112*	*4,993*	*646*	*2,214*	*77,344*	1,048	0
City of Skopje Saraj	40	512	386	0	0	552	386
TOTAL City of Skopje	*1,152*	*5,505*	*1,032*	*2,214*	*77,344*	*1,600*	*386*
Arachinovo	20	159	0	2	0	177	0
Zelenikovo	0	42	535	55	120	0	470
Ilinden	14	122	398	171	4,298	0	0
Petrovets	0	141	231	60	970	16	0
Studenichani	22	151	296	0	0	173	296
Sopishte	7	27	609	12	1,510	0	0
Chucher - Sandevo	7	82	431	80	0	9	431
TOTAL –Skopje Region	**1,222**	**6,229**	**3,530**	**2,594**	**84,242**	**1,975**	**1,583**

**Covered by PUE "Komunalna Higiena"*

Table 7-4: Results of calculations for recyclable waste containers in Skopje Region

Municipality	Number of 1.1 m^3 bins (commerce & industry)	Number of 1.1 m^3 bins (houses)	Bins in place	Bins to be purchased
Aerodrom	198	886		
Butel	100	441		
Gazi Baba	180	932		
Karposh	154	707		
Kisela Voda	160	687		
Chair	183	777		
Centar	131	557		
Gjorche Petrov	104	494		
Shuto Orizari	60	267		
*City of Skopje**	*1,270*	*5,748*	*1,436*	*5,582*
City of Skopje Saraj	47	594	0	641
TOTAL City of Skopje	*1,317*	*6,342*	*1,436*	*6,223*
Arachinovo	22	181	0	203
Zelenikovo	0	61	5	56
Ilinden	16	150	0	166
Petrovets	0	170	0	170
Studenichani	25	177	0	202
Sopishte	7	56	0	63
Chucher - Sandevo	8	114	0	122
TOTAL – Skopje Region	**1,395**	**7,251**	**1,442**	**7,205**

**Covered by PUE "Komunalna Higiena"*

Table 7-5: Results of calculations for home composting bins in Skopje Region

Municipality	Number of persons per household	Number of households	Home composting bins to be purchased
Aerodrom	3.5	602	121
Butel	3.5	293	59
Gazi Baba	3.5	2,379	480
Karposh	3.5	668	135
Kisela Voda	3.5	118	24
Chair	3.5	0	0
Centar	3.5	0	0
Gjorche Petrov	3.5	796	160
Shuto Orizari	3.5	147	30
City of Skopje (covered by "Komunalna Higiena")	*3.5*	*5,004*	*1,009*
City of Skopje Saraj	3.5	5,650	1,138
TOTAL City of Skopje	*3.5*	*10,653*	*2,147*
Arachinovo	5.1	813	164
Zelenikovo	4.0	989	206
Ilinden	3.7	1,784	362
Petrovets	4.0	1,888	388
Studenichani	4.8	1,291	266
Sopishte	3.7	602	127
Chucher - Sandevo	3.7	1,400	286
TOTAL –Skopje Region	**3.5**	**19,421**	**3,946**

In total, the needs for waste collection equipment in Skopje Region include:

- ✓ **1,975** metal bins of 1.1 m^3 capacity
- ✓ **7,205** plastic bins of 1.1 m^3 capacity
- ✓ **1,583** plastic bins of 120 lt capacity
- ✓ **3,946** home composting bins

7.1.2 Collection, transportation and transfer

In order to determine the suitable number of transportation trucks, the information provided by the municipalities through the questionnaires was taken and evaluated. Those data are presented in the Assessment Report of the region and are summarized in the following table:

Table 7-6: Current transportation equipment per municipality

Municipality	Vehicle type	Capacity (m^3)	Age (years)	Age <8 years	Total vehicles
Aerodrom	Compaction vehicles	16	6	6	9
	Compaction vehicles	12	13		
	Compaction vehicles	3	1		
	Compaction vehicles	3	3		
	Compaction vehicles	3	1		
	Compaction vehicles	20	25		
	Compaction vehicles	20	4		
	Compaction vehicles	18	15		
	Compaction vehicles	8	4		
Arachinovo	-	-	-	-	-
Chucher-Sandevo	Compaction vehicles	8,59	37	1	1
City of Skopje	Compaction vehicles	20	5	72	112
City of Skopje	Compaction vehicles	20	5		
City of Skopje	Compaction vehicles	20	5		
City of Skopje	Compaction vehicles	20	5		
City of Skopje	Compaction vehicles	20	5		
City of Skopje	Compaction vehicles	20	5		
City of Skopje	Compaction vehicles	20	13		
City of Skopje	Compaction vehicles	20	13		
City of Skopje	Compaction vehicles	20	13		
City of Skopje	Compaction vehicles	20	13		
City of Skopje	Compaction vehicles	20	28		
City of Skopje	Compaction vehicles	20	25		
City of Skopje	Compaction vehicles	20	4		
City of Skopje	Compaction vehicles	20	4		
City of Skopje	Compaction vehicles	20	4		
City of Skopje	Compaction vehicles	18	15		
City of Skopje	Compaction vehicles	18	16		
City of Skopje	Compaction vehicles	16	7		
City of Skopje	Compaction vehicles	16	7		
City of Skopje	Compaction vehicles	16	7		
City of Skopje	Compaction vehicles	16	7		
City of Skopje	Compaction vehicles	16	6		
City of Skopje	Compaction vehicles	16	6		
City of Skopje	Compaction vehicles	16	14		
City of Skopje	Compaction vehicles	16	19		
City of Skopje	Compaction vehicles	16	4		
City of Skopje	Compaction vehicles	16	4		
City of Skopje	Compaction vehicles	16	4		
City of Skopje	Compaction vehicles	16	22		
City of Skopje	Compaction vehicles	16	28		
City of Skopje	Compaction vehicles	12	13		
City of Skopje	Compaction vehicles	12	17		
City of Skopje	Compaction vehicles	12	30		
City of Skopje	Compaction vehicles	12	15		
City of Skopje	Compaction vehicles	12	13		

Municipality	Vehicle type	Capacity (m^3)	Age (years)	Age <8 years	Total vehicles
City of Skopje	Compaction vehicles	8	4		
City of Skopje	Compaction vehicles	8	4		
City of Skopje	Compaction vehicles	8	4		
City of Skopje	Compaction vehicles	8	4		
City of Skopje	Compaction vehicles	8	4		
City of Skopje	Compaction vehicles	8	4		
City of Skopje	Compaction vehicles	8	4		
City of Skopje	Compaction vehicles	8	4		
City of Skopje	Compaction vehicles	8	4		
City of Skopje	Compaction vehicles	8	4		
City of Skopje	Compaction vehicles	5	7		
City of Skopje	Compaction vehicles	5	7		
City of Skopje	Compaction vehicles	5	3		
City of Skopje	Compaction vehicles	5	3		
City of Skopje	Compaction vehicles	5	3		
City of Skopje	Compaction vehicles	5	3		
City of Skopje	Compaction vehicles	5	3		
City of Skopje	Compaction vehicles	5	15		
City of Skopje	Compaction vehicles	3	3		
City of Skopje	Compaction vehicles	3	3		
City of Skopje	Compaction vehicles	3	3		
City of Skopje	Compaction vehicles	3	3		
City of Skopje	Compaction vehicles	3	3		
City of Skopje	Compaction vehicles	3	3		
City of Skopje	Compaction vehicles	3	3		
City of Skopje	Compaction vehicles	3	3		
City of Skopje	Compaction vehicles	3	3		
City of Skopje	Compaction vehicles	3	3		
City of Skopje	Compaction vehicles	3	1		
City of Skopje	Compaction vehicles	3	1		
City of Skopje	Compaction vehicles	3	1		
City of Skopje	Compaction vehicles	3	1		
City of Skopje	Compaction vehicles	1,1	2		
City of Skopje	Compaction vehicles	1,1	2		
City of Skopje	Compaction vehicles	1,1	2		
City of Skopje	Compaction vehicles	1,1	2		
City of Skopje	Compaction vehicles	1,1	2		
City of Skopje	Compaction vehicles	1,1	2		
City of Skopje	Compaction vehicles	1,1	2		
City of Skopje	Compaction vehicles	1,1	2		
City of Skopje	Compaction vehicles	1,1	2		
City of Skopje	Compaction vehicles	1,1	2		
City of Skopje	Compaction vehicles	20	19		
City of Skopje	Compaction vehicles	20	17		
City of Skopje	Compaction vehicles	20	21		
City of Skopje	Compaction vehicles	20	4		
City of Skopje	Compaction vehicles	20	4		
City of Skopje	Compaction vehicles	22	1		
City of Skopje	Compaction vehicles	22	1		
City of Skopje	Compaction vehicles	20 T	18		
City of Skopje	Compaction vehicles	20 T	18		
City of Skopje	Open trucks	7 T	15		
City of Skopje	Open trucks	7 T	32		

Municipality	Vehicle type	Capacity (m^3)	Age (years)	Age <8 years	Total vehicles
City of Skopje	Open trucks	7 T	32		
City of Skopje	Open trucks	7 T	16		
City of Skopje	Open trucks	5 T	4		
City of Skopje	Open trucks	5T	4		
City of Skopje	Open trucks	20	9		
City of Skopje	Open trucks	20	9		
City of Skopje	Open trucks	30	8		
City of Skopje	Open trucks	30	8		
City of Skopje	Open trucks	20	19		
City of Skopje	Open trucks	5 T	29		
City of Skopje	Open trucks	10 T	18		
City of Skopje	Open trucks	14 T	16		
City of Skopje	Open trucks	7,9 T	1		
City of Skopje	Other	8	20		
City of Skopje	Other	2,4 T	20		
City of Skopje	Other	11 T	16		
City of Skopje	Other	3,8 T	27		
City of Skopje	Other	2,4 T	15		
City of Skopje	Other	2,5 T	7		
City of Skopje	Other	2,4 T	17		
City of Skopje	Other	2,5 T	18		
City of Skopje	Other	1,3 T	13		
City of Skopje	Other	1,3 T	13		
City of Skopje	Other	2,5 T	7		
Gazi Baba	-	-	-	-	-
Gjorce Petrov	-	-	-	-	-
Ilinden	Compaction vehicles	8	17	5	0
Ilinden	Compaction vehicles	8	17		
Ilinden	Compaction vehicles	18	32		
Ilinden	Compaction vehicles	20	18		
Ilinden	Open trucks	5,5	32		
Karposh	-	-	-	-	-
Kisela Voda	-	-	-	-	-
Butel	-	-	-	-	-
Cair	-	-	-	-	-
Centar	-	-	-	-	-
Petrovets	Compaction vehicles	20	13	2	0
Petrovets	Compaction vehicles	16	17		
Saraj	-	-	-	-	-
Shuto Orizari	Compaction vehicles	20	27	9	6
Shuto Orizari	Compaction vehicles	16	21		
Shuto Orizari	Compaction vehicles	5	6		
Shuto Orizari	Open trucks	1,1	5		
Shuto Orizari	Open trucks	1,1	5		
Shuto Orizari	Open trucks	1,1	5		
Shuto Orizari	Open trucks	1,5	5		
Shuto Orizari	Open trucks	1,3	5		
Shuto Orizari	Other	1,5	/		
Sopiste	Compaction vehicles	16	19	3	0
Sopiste	Compaction vehicles	5	15		
Sopiste	Open trucks	3,5	13		
Studenicani	Compaction vehicles	5193 kg	5	1	1
Zelenikovo	Compaction vehicles	4770 kg	6	1	1

The existing Feasibility Study proposes press-pack, rear-end 14m^3 compaction trucks with a payload of about 7 t, as a main type of trucks for mixed waste transportation in Skopje region. The decision is taken based on the geomorphology (terrain) of the municipality, the status of road network, the settlement population and the communication with the authorities. Trucks which are currently in operation and are older than 8 years (Table 7-6), are assumed to be outdated and were not considered for the calculations.

The following assumptions were further adopted:

- The truck capacity will be 14m^3 for both mixed and recyclable waste.
- The truck capacity will be 6m^3 for green waste.The average waste density in trucks for mixed and recyclable waste was considered as 0.5 t/m^3
- The average waste density in truck for green waste was considered as 0.22 t/m^3.
- The truck utilization is considered at 85% for mixed and recyclable and green waste trucks.
- Vehicles that are in use more than eight (8) years are not considered capable of being in service.
- For the municipalities that have trucks that can be utilized, their number and capacity was taken into consideration for the calculations.
- The average distances to the Transfer Stations or to the RWMF are used
- Average travelling speed is 40 km/h.
- Effective working hours/shift: 7.5 h

During the technical meetings with the Authorities and because of the relatively small size of the municipalities, it has been agreed that trucks which carrying recyclable waste should be shared among them. The same can be taken for the 6 m^3 green waste open trucks.

Additionally, for all municipalities where calculations show that current number of trucks which collecting mixed waste exceeds future needs for collection of that waste stream, transforming a mixed waste trucks to a recyclables truck in the future will be assumed, in order to reduce investments. This has been decided in order to optimize the collection cost.In relation to the grouping of municipalities, within City of Skopje, for all municipalities in which PUE "Komunalna Higiena" is in charge for collection and transport of waste, are considered as one group. For other municipalities in region grouping was based on the proximity and waste generation rates.As a first approximation, municipalities are grouped namely as follow:

- Aerodrom, Butel, Gazi Baba*, Gjorche Petrov, Karposh, Kisela Voda, Centar, Chair and Shuto Orizari;
- Arachinovo, Ilinden* and Petrovets;
- Zelenikovo, Studenichani* and Sopishte
- Saraj
- Chucher - Sandevo

The largest municipality (*marked with **) will host and accordingly assign the trucks for recyclables and green waste to other municipalities in group. In the following tables the calculations for the extra number of trucks required per municipality are presented for the three waste streams: mixed municipal, recyclables and green waste.

Table 7-7: Needs for mixed waste transportation trucks in Skopje Region

Compaction trucks	Aerodrom	Butel	Gazi Baba	Gjorche Petrov	Karposh	Kisela Voda	Centar	Chair	Shuto Orizari	Arachinovo	Ilinden	Petrovets	Zelenikovo	Studenichani	Sopishte	Saraj	Chucher-Sandevo
Choose truck capacity (m3)	**14**									**14**			**14**			**14**	**14**
Average pay load, t	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3	6,3
Utilization of capacity	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Average utilized payload, t	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4
Availability of trucks (for cleaning and maintenance)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Average distance to disposal site/ TS, km	12	8	1	14	7	12	14	16	1	8	8	14	19	10	13	16	10
Average speed when travelling, km/h	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Average time to and from disposal site/TS, h	0,80	0,53	0,07	0,93	0,47	0,80	0,93	1,07	0,07	0,53	0,53	0,93	1,27	0,67	0,87	1,07	0,67
Average time on disposal site/TS, h	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50
Total time traveling/trip, h	1,30	1,03	0,57	1,43	0,97	1,30	1,43	1,57	0,57	1,03	1,03	1,43	1,77	1,17	1,37	1,57	1,17
Time for emptying one container, min	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Time to drive to next container	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Average weight loaded, t/ "wet bin"	0,168	0,168	0,168	0,168	0,168	0,168	0,168	0,168	0,168	0,168	0,168	0,168	0,168	0,168	0,168	0,168	0,168
Loading efficiency/hour, t/h	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4
Loading time for loading a truck totally, h	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59
Total time per first trip	2,89	2,62	2,16	3,02	2,56	2,89	3,02	3,16	2,16	2,62	2,62	3,02	3,36	2,76	2,96	3,16	2,76
Buffer time, h	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50
Total time driving/loading/unloading, h	3,4	3,1	2,7	3,5	3,1	3,4	3,5	3,7	2,7	3,1	3,1	3,5	3,9	3,3	3,5	3,7	3,3
Remaining time for second trip	4,6	4,9	5,3	4,5	4,9	4,6	4,5	4,3	5,3	4,9	4,9	4,5	4,1	4,7	4,5	4,3	4,7
Maximum number of possible trips per day	2,4	2,6	3,0	2,3	2,6	2,4	2,3	2,2	3,0	2,6	2,6	2,3	2,1	2,5	2,3	2,2	2,5
Selected trips per day	2,0	2,0	3,0	2,0	2,0	2,0	2,0	2,0	3,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
Average load collected/day	12,63	13,71	16,12	12,16	14,01	12,63	12,16	11,71	16,12	13,71	13,71	12,16	11,11	13,15	12,39	11,71	13,15
Compaction trucks required (including reserve)	**4,1**	**1,9**	**3,1**	**2,3**	**2,9**	**3,3**	**2,8**	**4,0**	**1,0**	**0,6**	**0,4**	**0,4**	**0,2**	**0,6**	**0,2**	**1,8**	**0,3**
Compaction trucks in place	6,4	3,2	6,3	3,5	5,0	5,0	4,0	5,7	1,9	0,0	0,0	0,0	0,6	0,7	0,0	0,0	0,0
Final number of trucks required	-2,2	-1,3	-3,3	-1,2	-2,1	-1,8	-1,2	-1,7	-1,0	0,6	0,4	0,4	-0,3	-0,1	0,2	1,8	0,3
New Trucks to be purchased	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**1,0**	**1,0**	**1,0**	**0,0**	**0,0**	**1,0**	**2,0**	**1,0**
																	TOTAL - SKOPJE REGION: 7

Table 7-8: Needs for recyclable waste transportation trucks in Skopje Region

Compaction trucks	Aerodrom	Butel	Gazi Baba	Gjorche Petrov	Karposh	Kisela Voda	Centar	Chair	Shuto Orizari	Arachinovo	Ilinden	Petrovets	Zelenikovo	Studenichani	Sopishte	Saraj	Chucher-Sandevo
Choose truck capacity (m3)	**14**									**14**			**14**			**14**	**14**
Average pay load, t	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2
Utilization of capacity	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Average utilized payload, t	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6
Average distance from main to shared municipality, km	3	7	0	13	10	6	6	5	10	10	0	15	11	0	15	0	0
Average distance to disposal site/ TS, km	12	8	2	14	7	12	14	16	1	8	8	14	19	10	13	16	10
Average speed when travelling, km/h	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Average time to and from disposal site/TS, h	1,00	1,00	0,13	1,80	1,13	1,20	1,33	1,40	0,73	1,20	0,53	1,00	2,00	0,67	1,87	1,07	0,67
Average time on disposal site/TS, h	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50
Total time traveling/trip, h	1,50	1,50	0,63	2,30	1,63	1,70	1,83	1,90	1,23	1,70	1,03	1,50	2,50	1,17	2,37	1,57	1,17
Time for emptying one container, min	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Time to drive to next container, min	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Average weight loaded, t/ "dry bin"	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112
Loading efficiency/hour, t/h	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2
Loading time for loading a truck totally, h	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59	1,59
Total time per first trip	3,09	3,09	2,22	3,89	3,22	3,29	3,42	3,49	2,82	3,29	2,62	3,09	4,09	2,76	3,96	3,16	2,76
Buffer time, h	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50
Total time driving/loading/unloading, h	3,6	3,6	2,7	4,4	3,7	3,8	3,9	4,0	3,3	3,8	3,1	3,6	4,6	3,3	4,5	3,7	3,3
Remaining time for second trip	4,4	4,4	5,3	3,6	4,3	4,2	4,1	4,0	4,7	4,2	4,9	4,4	3,4	4,7	3,5	4,3	4,7
Maximum number of possible trips per day	2,2	2,2	2,9	1,8	2,1	2,1	2,0	2,0	2,4	2,1	2,6	2,2	1,7	2,5	1,8	2,2	2,5
Selected trips per day	2,0	2,0	2,0	1,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	1,0	2,0	1,0	2,0	2,0
Average load collected/day	7,14	7,14	7,14	3,57	7,14	7,14	7,14	7,14	7,14	7,14	7,14	7,14	3,57	7,14	3,57	7,14	7,14
Compaction trucks required (including availability)	**19,4**									**1,0**			**1,0**			**1,2**	**0,2**
Number of excess trucks (from mixed waste)	15,7									0,0			0,4			0,0	0,0
Compaction trucks in place	0									0			0			0	0
New Trucks to be purchased	**4,0**									**1,0**			**1,0**			**2,0**	**1,0**
																	TOTAL - SKOPJE REGION: 9

Table 7-9: Needs for green waste transportation trucks in Skopje Region

Item	Unit	Aerodrom	Butel	Gazi Baba	Gjorche Petrov	Karposh	Kisela Voda	Centar	Chair	Shuto Orizari	Arachinovo	Ilinden	Petrovets	Zelenikovo	Studenichani	Sopishte	Saraj	Chucher-Sandevo
Total Quantity green waste	tons/a	1.384	689	1.345	751	1.093	1.097	888	1.248	420	209	165	119	67	222	73	637	106
Daily Quantity green waste	tons/d	4,4	2,2	4,3	2,4	3,5	3,5	2,8	4,0	1,3	1,3	1,1	0,8	0,4	1,4	0,5	2,0	0,7
Assumptions																		
Days of waste transportation/week	days/week	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Effective working hours/shift	hours	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
Number of shifts	per day	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Required working days of service	days/year	312	312	312	312	312	312	312	312	312	156	156	156	156	156	156	312	156
Transportation trucks for Green waste																		
Capacity of trucks	m3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Average waste density in truck	t/m3	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22
MW Container load	tons	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3
Utilization	of capacity	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Number of trucks filled per day		4,0	2,0	3,8	2,1	3,1	3,1	2,5	3,6	1,2	1,2	0,9	0,7	0,4	1,3	0,4	1,8	0,6
Average trips of Green waste transport trucks per day																		
Average time for loading	hours	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Average distance to TS and back	km	24	16	4	28	14	24	28	32	2	16	16	28	38	20	26	32	20
Average speed when travelling	km/h	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	40
Total time loading/driving/unloading	hours	2,8	2,5	2,1	2,9	2,5	2,8	2,9	3,1	2,1	2,5	2,5	2,9	3,3	2,7	2,9	3,1	2,5
Required trips per day	trips/day	4,0	2,0	3,8	2,1	3,1	3,1	2,5	3,6	1,2	1,2	0,9	0,7	0,4	1,3	0,4	1,8	0,6
Total time needed for required trips (h)		11,1	5,0	8,2	6,3	7,7	8,8	7,4	10,9	2,5	3,0	2,4	2,0	1,2	3,4	1,2	5,6	1,5
No trucks required	#	1,4	0,6	1,0	0,8	1,0	1,1	0,9	1,4	0,3	0,4	0,3	0,2	0,2	0,4	0,1	0,7	0,2
Equipment																		
No extra trucks required	#	1,4	0,6	1,0	0,8	1,0	1,1	0,9	1,4	0,3	0,4	0,3	0,2	0,2	0,4	0,1	0,7	0,2
						9						**1**			**1**		**1**	**1**
																		TOTAL - SKOPJE REGION: 13

Overall, the needs for waste transportation equipment in Skopje Region include:

- ✓ **7** 14 m^{3}collection trucks for mixed waste
- ✓ **9** 14 m^3 collection trucks for recyclables
- ✓ **13** open trucks 6 m^3 capacity

7.1.2.1 The TS sites and their characteristics

For the municipalities that don’t transfer their municipal waste directly to the „Drisla“ CWMF, the collection trucks will transfer the waste to the Transfer Station that servers them. The transportation of waste to the Transfer Stations will minimize the routes to Drisla CWMF resulting in positive environmental and financial impacts.The maximum numbers of Transfer Stations that can be constructed in Skopje Region are two:

- Shuto OrizariTS
- Vardarishte TS – Gazi Baba

Transfer Technology
The method used to handle waste at the transfer station from the time it is unloaded by collection vehicles until it leaves the site is central to any transfer station’s design. The waste streams that will be transferred through the transfer stations are mixed residual waste, recyclable waste and green waste.

Transfer Stations will include:

- Entrance control and fencing
- Weighbridge with data recorder
- Access roads
- Administration building
- Parking area
- Surrounding planting
- Discharge hoppers
- Electrical installation
- Hydraulic installations
- Storm water protection works
- Press containers
- Green waste container
- Bulky waste

Main entrance and fencing
The perimeter of the Transfer Station area will be protected via a fence that will provide protection against access by unauthorized persons and animals. It will be made of galvanized iron ducts of 5 cm, with 2.50 m height, which will be encased in a concrete basis below the ground. The edges of the ducts will be connected with prickle wire net, which will be installed in 2 rows. A rhomboid wire net with loops will be used to restrict the trespassing of rodents. The distance between the ducts will be 3 m, and every 6 m iron struts of the same diameter as the ducts will be placed. The entrance gate consists of two doors with 4 m length and 2.5 m height each. The entrance doors will automatically open. The doors will be coated with

wire net and be secured with a lock. A sign board shall be placed at the entrance to allow easy identification.

Weighbridge

The accurate and systematic recording of incoming waste is an important monitoring element. Thus, a fully electronic weighbridge will be installed in each TS. All incoming vehicles must be weighed before unloading the waste. The specific type and its dimensions will be defined during the elaboration of detailed design.

The Weighbridge shall be in accordance with the specifications below:

- Weighbridge capacity: 60 tons with maximum intervals of 20 kg
- Size approximately 18 x 3m

Internal roads

Transfer stations typically include roadways for vehicles. Transfer trucks for long distance hauling need wide roadways with gradual slopes and curves to maneuver efficiently and safely. Also, the site will need space for parking transfer vehicles and to allow incoming and outgoing traffic to form lines without backing up onto public roads.The transfer stations will have two levels (loading area level and unloading area level) and so there is the need to have vehicle access. Completely flat sites need ramps, constructed to allow vehicle access to upper level (or areas excavated to allow access to lower level).

The alignment of the internal roads serves the Collection Trucks to the upper level and the hook lift trucks to the lower level. The design speed is estimated Ve= 30km/h.There will be two internal roads. One to serve the access of the hook lift trucks (long distance hauling trucks) to the lower level for loading the press containers and the other to serve the waste collection trucks to the upper lever for waste unloading. The internal roads will be paved and are designed for one lane per direction, 8.0 meters’ width in total.Curves and intersections in or near the transfer station site need large turning radius to enable turns of the trucks. Due to site restrictions, the smallest horizontal curve is 15 meters which is acceptable due to low travelling speeds.

Slopes on ramps should be limited to less than 8 percent, particularly for fully loaded transfer trucks. The maximum slope used is 8.0%. The proposed cross slope at straight sections of both roads is 2.5% which is acceptable due to low travelling speeds. In curved sections the cross slopes will be maximum 5%.
Driving surfaces will be paved to minimize dust generation. The proposed pavement as follows:

- 4 cm of high density asphalt mixture
- 8 cm of low density asphalt mixture
- 10 cm of Foundation layer
- 20 cm of Sub-base layer

In order to protect the drivers and pedestrians signing and striping of roads is mandatory:

- Dashed white stripe 12 cm wide for internal marking
- Continuing white stripe 12 cm wide for external marking
- 30 cm wide white line for Stop Lines

Road signing:

Administration building

This building serves the administration staff and stores the necessary equipment for monitoring, recording the incoming waste, and weighing the incoming vehicles. Each TS will have an administration building of approx. 60 m^2, one-store, rectangular shape located opposite to the weighting area, which will include:

- Main Entrance
- Weighbridge Control Office
- Office
- Kitchen
- Changing rooms, shower area and WC
- Medical assistance area

Parking area

The vehicles of the employees and visitors of the TS will be parked in an open parking opposite to the administrative building. Four parking position will available with dimensions of 2.5 x 5.0 m each.

Surrounding planting

For a protective zone of greenery, trees will be planted lengthways of the fence in the TS area if possible, in all around the perimeter zone. The trees must be suitable for the local climate and will be used for minimizing the visible impact. An irrigation channel will provide the potable water necessary for the plants, which is connected with the water tank.

Metallic hoppers

The selected type of transfer station is direct discharge transfer station with mobile compaction. Waste is discharged, through a metallic hopper, directly into the upper side hatch of the press container, which once it reaches its full capacity it will be transported to "Drisla" CWMF with the hook lift truck. The hopper must have in the upper part adequate opening so that the waste collection vehicles will be able to discharge the collected waste.In its lower part the hopper must fit to the opening of the mobile compactor so that no waste will be falling outside of the mobile compactor during the transferring procedure.The hopper will be robust metal construction, easy to assemble and disassemble it. The main body is split into two sections and perimeter screens will be all removable and variable height depending on the circumstances and requirements. It is made of steel and the support will be at ground level with concrete beams and columns. In order to avoid garbage dispersion, due to winds, the hoppers have a metal tube structure above.

Electrical installations (lighting, electricity, phone)

The plant shall be electrically connected to the Medium Voltage (MV) electricity network of the area. It is foreseen that MV electrical supply has been provided from public electrical network up to the entrance of transfer station. Scope of the pricing is started from that point.

Hydraulic installations

Service water supply system

A small water pumping set (SWPS), fed by the water tank, will be installed ensuring the supply of water to all premises. Water flow velocities in pipes shall be maintained between 1.5 to 3.0 m/s. Potable water will be supplied to the administration building by installing autonomous 20 lit. mineral potable water coolers.

Water tank

To supply the water booster set with water, a dedicated 15m^{3}water tank will be provided. The tank will be made of HDPE.

Water piping network

The piping network will be constructed with 8 bar nominal pressure HDPE piping according to EN 12201-2 with SDR 21, capable of withstanding 50% pressure above maximum.

Sewage system

Internal sewage system will be constructed, according to local regulations, via gravitational flow pipes to the main sewage tank.

Sewage design criteria:

Concerning the hydraulic design in general, the EN 752 standards are applied and the following design criteria are used for the needs of the sewage plan:

Manholes are provided at the following locations:

- at every direction change, level or slope
- at the junction of two or more pipes
- at the end of horizontal waste pipe before connected to the main sewerage
- and at maximum distance of 80m on straight sections of pipe work

Absolute minimum flow velocity in sewage pipes:

- 0.8m/s (fluid flow up to 15 lit/sec)
- 1.0m/s (fluid flow more than 15 lit/sec)

(According to EN 752 for small diameter drains and sewers (less than DN 300) self-cleansing can generally be achieved by ensuring either that a velocity of at least 0.7 m/s occurs daily, or that a gradient of at least 1:DN is specified.)

Maximum flow velocity in sewage pipes under the peak flow should be limited to:

- 1.5m/s (for flow 2.5-15 lit/sec)
- 1.75 (for flow 15-100 lit/sec)
- 2m/s (for flow 100-500 lit/sec)

Maximum depth of flow should be between 50% - 70% of pipe diameter under the peak flow (for safety reason the limit has been chosen to be up to 50%). Wastewater network shall be constructed taking into account local guidelines and regulations from the authorities.

Sewage tank & other elements:

The manholes that shall be used are pre-cast HDPE manholes. The manhole design will be according to EN 752 recommended dimensions for the construction of new manholes with personnel entry. For manholes located in sag locations where ponding will occur or low areas subject to inundation, an inflow allowance of 0.4 liters/sec shall be made for each manhole. The type of pipes that should be used to sewage network system is u-PVC pipes according to EN 1401/S41 series while the alternative HDPE pipes PN10 are also accepted. All sanitary sewers should be designed with a minimum slope of 0.4% or greater. All sewage effluent shall be conducted to the sewage tank, fabricated from HDPE.

Storm water protection works

Overall design of flood protection works

The main aims of the construction of flood protection works are the following:

- To avoid the inflow of storm water in the sites and in this way, protect its structural stability
- To protect the buildings and the roads of the sites from storm water erosion
- To protect the smooth functioning of the sites in the event of heavy rainfall.

The flood protection works of the sites consist of the following:

Storm water drainage system consisting of triangular ditches on the side of the roads, trapezoidal or rectangular ditches, wells, manholes which collect the storm water from the plateau of the buildings and lead them with safety. This system collects the storm water from the areas inside the borders of the site.

It should be noted here that crucial element of the flood protection system is the slope free surfaces of the ground inside the site: all the surfaces must be sloped towards the nearest ditch in order to prevent the retention of water in hollows of the ground. The slope of the free surfaces must be at least 0.4% with the directions shown in the general layouts of flood protection works.

Hydrology

The main aims of this section are the following:

- To avoid the inflow of storm water in the transfer stations and in this way, protect its structuralstability
- To avoid the inflow of storm water in the transfer stations and in this way, reduce the leachate production
- To protect the buildings and the roads of the site from storm water erosion

Runoff estimation method

The hydrological calculations will be for a return period of 20 years. A safety factor was also adopted for the maximum discharge that the ditches can convey. The ditches are dimensioned in order the height y of the flow during the design storm divided by the total height of the ditch h must be below 0.80, i.e. $y/h < 0.80$.

The calculation of the runoff was made using the rational method:

$$Q = 0.000278 \times c \times i \times (\text{lt/sec})$$

where:
c: runoff coefficient
i: rainfall intensity in the time of concentration (mm/hr):
A: area of catchments basin (m^2)

Runoff coefficient

For the runoff estimation of the roads, the runoff coefficient is equal to 0.90 based on the international literature on the particular subject.Finally, the runoff coefficient of the external catchment areas was calculated using the following formula (Mamassis 2008, Koutsogiannis and Xanthopoulos 1996):
C = 1 - C’1 - C’2 - C’3
The parameters presented above are for region characterized by average slope, saturated soil and sparse vegetation.

Ditch design – Hydraulic calculations

For the dimensioning of the ditches the Manning formula is used assuming that the continuity assumption is valid:

$$Q = A \times V \ (m^3/s)$$
$$V = (1/n) \times R^{2/3} \times S^{1/2}$$

where:
Q = discharge (m^3/s)
A = “wet” area (m^2)
V = velocity (m/s) (n) = manning coefficient
R = hydraulic radius (m)
S= slope

More specifically the calculations will be with the use of STONET, DRAINET software of ENCOSOFT, for pipes and open channels. The mathematical model of this program is based on the continuity equation and on Manning formula.

Fire Protection

Since there will be no storing of municipal waste at the TS (except for the containers for bulky waste), there is no need for hydrant protection. The possibility for fire spreading out is minimal and unrestricted access of fire fighting vehicles is possible.Truck and tractors arriving and leaving the TS already have fire protection (fire extinguishers).

Equipment:

Press containers

Hydraulic steel press containers of 24m^3 capacity will serve the purpose of compressing the residual mixed waste and the recyclable waste, reducing significantly their volume, which results to reduced transportation costs, but has also positive environmental impact. The press containers generally consist of the filling chamber, the pressure chamber, the back hatch, the drive assembly chamber, the electric-control panel, the emergency tank for liquids, the hydraulic cylinders, observation glass.

Skid Steer Loader

There will be a skid steer loader available in each TS, for various tasks, mainly for assisting the loading of green waste.

Bulky waste container
A container will be in place at the TS in order to gather bulky items that are either found in the collection vehicles or delivered to the TS by citizens. Full containers of bulky waste are transported to the CWMF.

The following Table presents the required civil works for the TSs.

Table 7-10: Required number of civil works per TS

Cost category	Shuto Orizari	Vardarishte
Fence	x	x
Entrance gate	x	x
Plato and roads	x	x
Administration building	cca 60 m^2	cca 60 m^2
Water supply	x	x
Sewerage system	x	x
Electrical installations (lighting, electricity, phone)	x	x
Hopper	2	2
Landscaping	x	x

The following Table presents the required mobile equipment for transfer stations.

Table 7-11: Required number of equipementper TS

Equipment	Shuto Orizari	Vardarishte
Weighbridge	1	0
Press containers 24m^3 (for mixed waste)	11	6
Press containers 24m^3 (for recyclable waste)	6	4
Containers 24 m^3 (for green waste)	3	2
Skid Steer Loader	1	1
Truck with hook lift	4	2

On the following figures (Figure 7-2 and Figure 7-3), general layouts of TSs in Shuto Orizari and Vardarishte in relation to the proposed locations, are shown. More detailed designs with appropriate legends are presented in Annex – General Layout of transfer Stations.

Figure 7-1: General layout of Shuto Orizari TS

Figure 7-2: General layout of Vardarishte TS

7.1.3 Analysis of existing dumpsites and non-compliant landfills

Information about locations and characteristics of all landfills and dumpsites within Skopje Region, are in detail described in Document *“Skopje Region – Assessment Report – Part B”*, as a part of overall Project “Preparation of necessary documents for establishing of an Integrated and Financially Self-sustainable Waste Management System in Pelagonija, Southwest, Vardar and Skopje Regions”. In this Sub-Chapter, main findings of that project are summarized.

Investigation of waste disposal locations was performed through direct collaboration with local authorities (LSGU’s environmental and planning departments or PUEs) in a form of direct interviews and questioner’s survey. During the site visits all additional sites noted by the contact persons from LSGUs, local inhabitants and/or spotted by project teams where visited and added to the lists. Data collected include information for waste disposal facility information, location, land property, PUE or other entity entitled to manage facility (if any) and other administrative information, period of waste disposal, protective technologies and controls used (if any) and disposed waste composition. Additional information regarding the local conditions including climate (rain, wind), geological and hydrogeological settings, hydrology, land cover and usage, sensitive areas and demographic data were collected with additional desk top research using official sources of data.

On site activities include but were not limited to:

- geologic reconnaissance and mapping (GPS survey, photo and geo-referencing data)
- identification of disposal methods (engineering and other controls) and disposed waste composition
- sensitive receptors identification (settlements, agricultural land or other usage, surface and underground waters, sensitive habitats…)

An elaborated data collection template was developed and comprehensive data file for each site visited generated. Data files include information on:

- general location topographic map, orto-photo map with cadaster information (area and contours of landfills and dumpsites were revised with GPS references) and photo documentation;
- type of waste disposed, area and thickness
- infiltration of water and / or gas separation
- drainage conditions (eroded areas, discharge to water bodies, etc.)
- conditions of the nearby reservoirs (if any)
- presence of vegetation - species characteristics and conditions
- sensitive areas locations (distance to playgrounds, schools and residential buildings, sensitive habitats, water catchment areas and water abstraction facilities, farmland and agricultural facilities, pools and streams)
- access/road network conditions
- characteristic of ground cover (if any)
- use of nearby areas - residential, agricultural use, recreation zones, water protected sites, reservoirs for public use - sports, swimming and more, industrial zones
- groundwater use in nearby settlements - wells and boreholes in the courts, the type of water use (drinking water, irrigation, etc.), depth of groundwater level.

All data collected where analyzed and organized according the requirements of the risk screening methodology adopted (RSS), and inventory of landfills were created. Inventory includes all technical and environmental information for:

- risk assessment for all waste facilities identified according to uniform methodology
- risk ranking and prioritization of waste facilities identified by various criteria;
- selection of closure and remediation approach, remediation activities distribution in time, and monitoring needs assessment.

Results of field investigations shows that small landfills or so called "dumpsites" without any engineering or other control measures for environmental protection, were identified in all 17 municipalities of Region. The dumpsites are usually created in areas where no organized waste collection services are available or unknown perpetrators trying to avoid disposal costs. Although small in size (area and volume) due to different types of wastes sometimes including biological waste, chemicals or even industrial wastes (sludge's) they can pose great risks to surrounding environment. In total 57 dumpsites were identified in the Skopje Region, with note that only official landfill in the region "Drisla", was not included in investigation.

Table 7-12: Identified dumpsites in Skopje Region

DumpsiteID	Municipality	Settlement	Latitude	Longitude	DumpsiteArea [m^2]	DumpsiteVolume [m^3]
RAIL001	Saraj	Laka	41°59'53.580"	21°21'23.759"	900	8100
RAIL002	Saraj	Krushopek	41°59'55.347"	21°20'32.811"	200	100
RAIL003	Saraj	Kondovo	42°0'25.2"	21°18'52.9"	100	70
RAIL004	Saraj	Rashche	42°01'19.8"	21°14'39.3"	300	300
RAIL005	Saraj	Rashche	42°00'59.9"	21°16'3.1"	400	400
RAIL006	Saraj	Rashche	42°01'0.9"	21°16'56.4"	100	50
RAIL007	Saraj	Bojane	41°58'58.604"	21°11'32.630"	2500	1300
RAIL008	Saraj	Glumovo	41°59'07.6"	21°18'13.6"	100	300
RAIL009	Karposh	Karposh	42°00'50.228"	21°22'18.707"	50	25
RAIL010	GjorchePetrov	GjorchePetrov	42°01'24.075"	21°53'53.229"	40000	40000
RAIL011	GjorchePetrov	Volkovo	42°02'59.16"	21°21'59.99"	700	700
RAIL012	GjorchePetrov	Orman	42°03'17.6"	21°21'48.5"	500	750
RAIL013	GjorchePetrov	Orman	42°03'31.32"	21°21'40.943"	900	900
RAIL014	Karposh	Karposh	42°00'39.79"	21°24'8.992"	50000	25000
RAIL015	Petrovets	Petrovets	41°56'25"	21°37'57.6"	150	450
RAIL016	Petrovets	Petrovets	41°55'59.9"	21°36'27.1"	100	50
RAIL017	Petrovets	Ognjanci	41°55'9.8"	21°35'13.1"	250	250
RAIL018	Petrovets	Rzinichino	41°55'17.1"	21°38'0.61"	350	700
RAIL019	Petrovets	Blace	41°52'47.5"	21°40'16.4"	150	75
RAIL020	Petrovets	Chiflik	41°56'18.6"	21°40'13.2"	50	25
RAIL021	Arachinovo	Arachinovo	42°01'45.9"	21°35'04.5"	450	1800
RAIL022	Arachinovo	Grushino	42°01'46"	21°35'27.6"	50000	150000
RAIL023	GaziBaba	Drma	41°57'5.5"	21°34'39.8"	150	75
RAIL024	GaziBaba	Jurumleri	41°57'47.2"	21°32'38.9"	8000	8000
RAIL025	GaziBaba	Smilkovci	42°01'49.1"	21°29'16.6"	30	45

DumpsiteID	Municipality	Settlement	Latitude	Longitude	DumpsiteArea [m^2]	DumpsiteVolume [m^3]
RAIL026	GaziBaba	Rashtak	42°4’43.9”	21°29’44.5”	100	100
RAIL027	GaziBaba	Ljuboten	42°5’55.6”	21°28’19”	200	400
RAIL028	GaziBaba	Rashtak	42°5’37.7”	21°28’57,3”	200	800
RAIL029	ChucherSandevo	Pobozje	42°6’43.6”	21°25’34.4”	200	800
RAIL030	ChucherSandevo	Kuchevishte	42°6’22.5”	21°24’28.5”	300	300
RAIL031	Sopishte	Sopishte	41°57’12.7”	21°25’25.55”	30	60
RAIL032	Sopishte	Rakotinci	41°56’17.4”	21°24’41.8”	200	400
RAIL033	Sopishte	Sopishte	41°56’56.3”	21°24’16.8”	250	1000
RAIL034	Sopishte	Chiflik	41°56’57.4”	21°20’29.8”	90	360
RAIL035	Sopishte	Chiflik	41°56’49.6”	21°21’16.8”	100	600
RAIL036	Sopishte	Jabolci	41°54’25.2”	21°19’50.3”	25	12.5
RAIL037	Sopishte	Varvara	41°54’35.4”	21°26’9.6”	100	50
RAIL038	Studenichani	Batinci	41°55’13.4”	21°28’7.4”	750	750
RAIL039	Zelenikovo	Taor	41°53’52.429”	21°36’34.406”	80	40
RAIL040	Zelenikovo	Pakoshevo	41°52’29.181”	21°36’47.215”	60	300
RAIL041	Zelenikovo	Zelenikovo	41°52’23.4”	21°36’30.4”	150	450
RAIL042	Zelenikovo	Strahojadishte	41°51’39.9”	21°36’26.9”	30	15
RAIL043	Zelenikovo	Zelenikovo	41°53’10.815”	21°35’15.187”	100	100
RAIL044	KiselaVoda	Lisiche	41°57’23.7”	21°29’32.8”	70	35
RAIL045	KiselaVoda	Lisiche	41°57’34.5”	21°29’42”	150	75
RAIL046	KiselaVoda	11Oktomvri	41°58’42.4”	21°27’6.9”	50	50
RAIL047	KiselaVoda	Teferich	41°57’57.3”	21°26’12.3”	500	500
RAIL048	KiselaVoda	Teferich	41°58’8.3”	21°26’26.3”	300	1200
RAIL049	Centar	Centar	42°00’39.8”	21°25’30.9”	50	100
RAIL050	Centar	Centar	42°00’32.2”	21°25’35.9”	100	20
RAIL051	Centar	Centar	41°59’49.7”	21°27’6.8”	20	10
RAIL052	Centar	Centar	41°59’1.1”	21°25’7”	15	7.5
AIL053	ShutoOrizari	ShutoOrizari	42°02’30.1”	21°24’59.8”	45000	22500
RAIL054	ShutoOrizari	ShutoOrizari	42°02’58.9”	21°25’7.9”	4000	2000
RAIL055	ShutoOrizari	ShutoOrizari	42°02’42.8”	21°24’30.3”	200	300
RAIL056	ShutoOrizari	ShutoOrizari	42°03’0.0”	21°24’25.5”	45000	90000
RAIL057	ShutoOrizari	ShutoOrizari	42°02’51”	21°24’26.5”	3000	3000
RAIL058	GaziBaba	Kvantashki pazar	41°59’11.7”	21°29’53.8”	2500	2500
RAIL059	GaziBaba	Kvantashki pazar	41°59’01.3”	21°30’05.9”	15000	67500

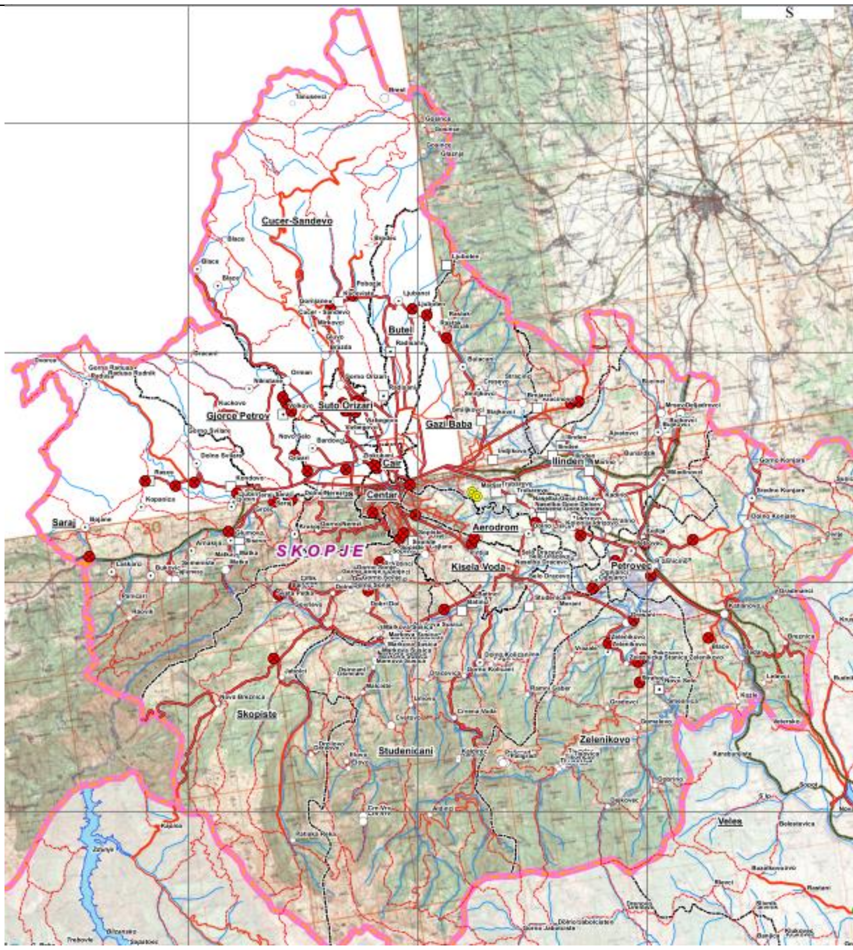


Figure 7-3: Locations od dumpsites in Skopje Region

Risk Assessment

As mentioned above, all data collected during the identification and site visits process are properly formatted and used as an input to RSS (Risk Screening System) template. RSS (Risk Screening System) presents site assessment system that is simplification of the original Rapid Hazard Assessment System (RHAS), based on the Canadian Classification System for Contaminated Sites (CCME, 1992). The RSS is based on a risk equation made up of the hazard/source, the exposure pathway and the receptor, as it shown at Figure 7-6.

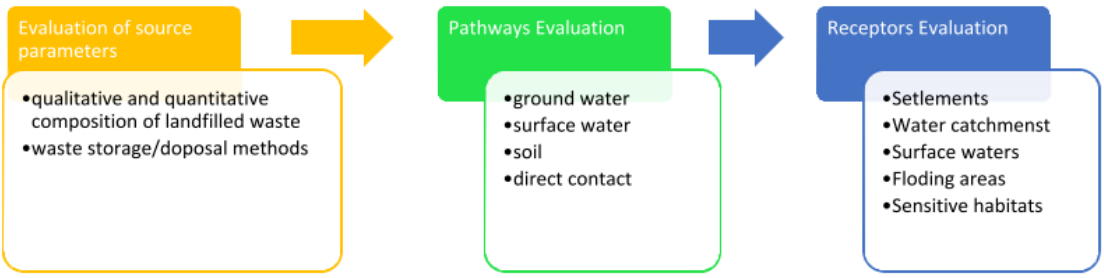


Figure 7-4: Risk assessment procedure

The presence of all three components means there is some level of risk, while the absence or near absence of any of the components means there is no or minimal risk.

The hazard/source and pathway components of the risk equation are defined by a variety of parameters that are considered to be the most important in determining the degree to which the hazard exists, or in defining whether a pathway to a receptor is completed. The equation is:

Risk = Hazard x Pathway x Receptor

where:
<u>Hazard</u> = Toxicity x Quantity x Mobility
<u>Pathway</u> = Containment x Pathway barrier 1 x pathway barrier 2 x ...(the likelihood of there being a complete pathway being defined by various barriers in the pathway), and:
<u>Receptor</u> = a single value between 0 and 1 defining the sensitivity or vulnerability of the receptor, whether people or an ecological environment.

A low value assigned to a parameter indicates a limitation to the overall risk (i.e., a small hazard, or a large barrier to contact or transport along a pathway, or a low sensitivity receptor), while high value suggests a high potential for risk. The combination of several high, low or intermediate values then gives a measure of the overall risk.

According to methodology all exposure pathways considered (surface water, groundwater and direct contact) are independently assessed and based on risk value calculated, all landfills are divided in three basic categories:

- Category I ($R \leq 0.02$) – Minimal (Low) Risk - Included in inventory with no additional investigations
- Category II ($0.02 \leq R \leq 0.4$) – Medium Risk - Included in inventory, additional investigation for environmental impacts
- Category III ($R \geq 0.4$) – High Risk - Additional investigations for environmental impacts and rehabilitation

From dumpsites included in the inventory, only three dumpsites are categorized in Category I (minimal/low risk), 6 dumpsites in Category III (high risk), while all other 50 dumpsites in Skopje region are categorized in Category II (medium risk). Summary of dumpsites ranking are shown in Table 7-6:, while more detailed data about particular dumpsites can be find in Document "Skopje Region – Assessment Report – Part B".

Table 7-13: Summary ofranking dumpsites by Risk category (Low, Medium, High)

Municipality	Dumpsites			
	Risk category			
	No	L	M	H
Saraj	8		8	
Gjorche Petrov	4		4	
Karposh	2		1	1
Petrovets	6	1	5	

Municipality	**Dumpsites**			
	Risk category			
	No	**L**	**M**	**H**
Arachinovo	2		1	1
Gazi Baba	6		4	2
Butel	2		2	
ChucherSandevo	2		2	
Sopishte	7		7	
Studenichani	1		1	
Zelenikovo	5		5	
Kisela Voda	5	2	3	
Centar	4		4	
Shuto Orizari	5		3	2
TotalforSkopje Region	**59**	**3**	**50**	**6**

Landfills prioritization

According to methodology for risk assessment, three sensitive pathways to a receptor were included in assessment: surface water, groundwater and direct contact exposure pathway. For each of this pathway to a receptor, and based on data collected/processed, Risk value for each landfill was calculated. Highest calculated values are used to make prioritization and planning activities for additional investigation and rehabilitation or planning future rehabilitation according their priority for each of landfills.

Landfills prioritization according time frame for necessary future activities

Prioritization of 59 dumpsites in Skopje region is based on calculations performed with RSS template and according the maximal calculated Risk value for surface water, groundwater and direct contact exposure pathway. Using the same methodology all dumpsites included in the inventory are divided in 3 groups according the actions priority (Table 7-7):

Table 7-14: Risk distribution and time frame of planning activities

Group	Activities need totaken	Timeframe	Risk range
I – minimal risk	Stays ininventory, no actionsneeded	Not defined	**R ≤ 0.02**
II – medium risk	Stays ininventoryand additional investigationsareneeded (monitoringand investigations)	Long term	**0.02 <R< 0.1**
		Mediumterm	**0.1 ≤ R< 0.4**
III – high risk	Additional investigationsfor environmental impactsand rehabilitation	Mediumterm	**0.4 ≤ R < 0.7**
		Short term	**R ≥ 0.7**

According to Survey of Landfills and Dumpsites that has been done in the framework of the present project (Part B of the Assessment report) two closed (in last 20 years) non-compliant MSW landfills were reported in Gazi Baba Municipality. Those sites were taken into consideration in order to include them in future remediation/closure plans.

Risk assessment according to highest Risk values and time frame for additional activities that are needed indicates that:

- 3 dumpsite (RAIL 020 in Petrovets and RAIL 047, RAIL 048 in Kisela Voda) are ranked in category I (low risk) so no actions needed;
- 18 dumpsite are ranked in category II (medium risk) (RAIL 004, RAIL 008 in Saraj, RAIL 009 in Karposh, RAIL 016, RAIL 019 in Petrovets, RAIL021 in Arachinovo, RAIL 025, RAIL 026, RAIL 059 in Gazi Baba,RAIL 027, RAIL 028 in Butel, RAIL 029, RAIL 030 in Chucher-Sandevo, RAIL031, RAIL034, RAIL036, in Sopishte,RAIL038 in Studenichani, RAIL050 in Centar, RAIL055 in Shuto Orizari) needs additional investigation and monitoring in long term plan, while the other 32 dumpsites from category II needs additional investigation and monitoring in medium term plan;
- 6 dumpsite (RAIL 014 in Karposh,RAIL 022 in Arachinovo,RAIL 024 and RAIL 058 in Gazi Baba, and RAIL 053, RAIL 05 in Shuto Orizariare ranked in category III (high risk) needs additional investigations for environmental impacts and rehabilitation in medium term plan.

7.2 Operational description of the waste management system

7.2.1. Collection

The basic requirements for development of the collection system in Skopje Region are:

- Achievement of near complete (close to 100%) coverage with waste collection services
- The provision of containers for all residual waste collection
- Frequencies of at least once per week – higher frequencies in urban areas
- At least one waste reception / collection centre("civic amenity site/recycling yard") in each municipality

The future concept of waste collection, implies a somewhat different system of municipal waste collection compared to the current one, namely it is proposed to implement the so-called "2-bin system" where the two streams of municipal waste should be collected separately.

In one bin all of the "dry" waste fraction would be collected, which mainly includes various kinds of recyclable materials such as plastic, paper, cardboard, fibres, rubber, glass, leather, metal, etc., while in the other, the so-called "wet" bin, all of the remaining waste (i.e. the 'residual' waste) would be collected, which would largely consist from the biodegradable waste fractions (residues from food, garden waste), as well as other factions, such as diapers, soil, ash, etc.

The concept anticipates that waste collection is carried out on a daily basis in urban areas, or in the central parts of the municipalities, namely in areas with the prevailing collective type of housing (i.e. apartments in high-rise buildings), while the frequency of waste collection in rural areas or in areas with the dominant individual type of housing, it is carried out at least once per week. In the first phase of implementation of the system of waste collection in 2 bins, it would be necessary to work on raising awareness and educating the population on primary source separation of waste. However, experience shows that in spite of such actions, it is not realistic to expect the efficiency of primary separation of waste generated by residents to be 100%.

Beside, "regular" households waste, collection of recyclable, but also hazardous and special waste streams will be performed through collection centers, which are sometimes referred to as "civic amenity sites" or "green points" or "recycling yards". Waste collected in collection centers refer to separately collected recyclable fraction, but also all waste fractions that are not suitable for placement in the regular waste containers by virtue of their size or nature. For the Skopje Region, construction at least one collection center, is planned in each municipality.

According to Skopje Regional Waste Management Plan, additional 2,201 t/year of recyclable fraction (1.18% of total generated waste, i.e. 3% of recyclable materials fraction, 15% of wood packaging fraction, 3.2% of packaging waste fraction), will be separately collected through the Green points placed at different locations in municipalities. Proposed number of Civic Amenity Sites (green points) in Skopje Region is 15.

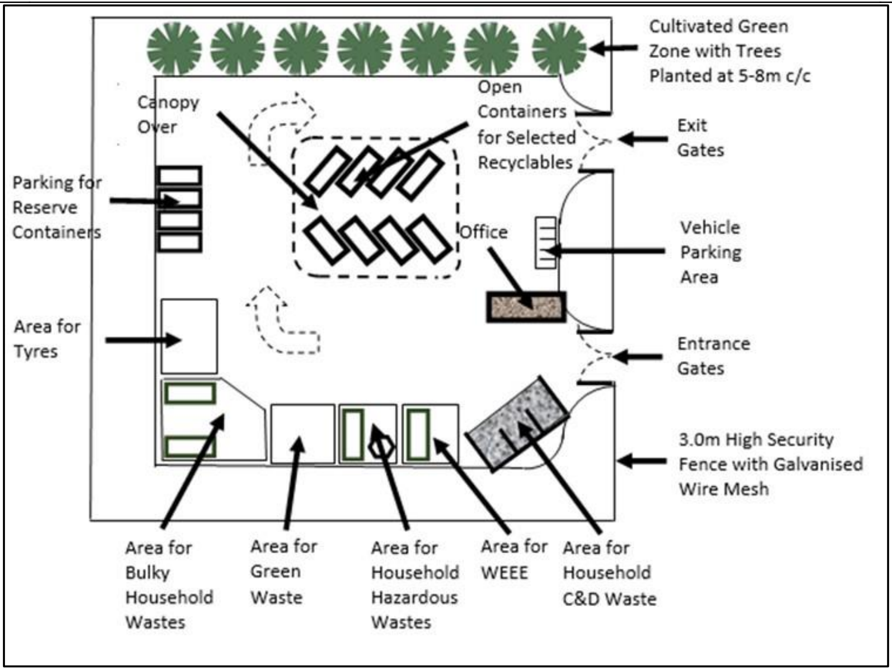


Figure 7-5: Sketch of typical Civic Amenity Site (green point)

The main purpose of these Civic Amenity Sites (green points) would be temporary storage of specific waste streams, such as bulky waste, waste household electrical and electronic equipment - WEEE, batteries, tyres, etc. Although storage of highly hazardous wastes such as materials with flammable and explosive characteristics, medical, chemical, radioactive waste, animal waste, etc., will not be allowed in these collection centres, certain categories of less hazardous waste (for which adequate storage may be provided) may be accepted. This primarily refers to waste such as waste motor oil, asbestos, fluorescent tubes, PCB, paints, solvents, pesticides, etc. Typical layout of a waste reception / collection centre (i.e. also referred to as a "recycling yard" or "civic amenity centre") is illustrated in Figure 7-24 below.

Figure 7-6: Example of Civic Amenity Site (green point) for specific waste streams

Primarily sorted waste is deposited in specific containers by the citizens or by the PUE. The waste collected in the collection centres would be temporarily stored until final treatment, depending on the waste type.

Within the collection centre, only pre-selected waste is accepted, and selection of the waste on the station is only carried out on a basic level, in order to prevent possible mixing of different waste streams.

In certain cases, if there are spatial and other preconditions, collection and storage of specific waste types (C&D waste, old vehicles, as well as organic waste (bio-mass), etc.) may be possible on the site. However, in practice, those waste categories are mainly deposited at locations that are intended and specially designed for them.

In civic amenity sites, reuse centers can also be established. Citizens may bring items, especially WEEE but also furniture and textiles, normally because they are not functioning or torn, but also because they do not want it anymore or they have replaced it with a newer one. The condition of these items is afterwards checked, being fully reusable, needing slight or significant repair, or needing disposal. In the latter case, some spare parts may be in working condition. The citizens may collect the electrical appliance after repair. If it is unwanted or for furniture/ textiles, the reuse centres function as second-hand shops. For the region, it is interesting to note that schemes which involve preparation for re-use can be sources of employment and can provide re-training opportunities for those who have been out of work for some time. It can also target youth unemployment that can give young people practical skills and hands on experience, to be utilised at a later stage.

Separate collection of green waste are also considered. The assumption made is that the 40% of green waste fraction would be separately collected, i.e. 5.63% of total generated waste (10,512 t/y), while 97% of generated waste (green waste + biodegradable waste) will be locally utilized through home composting activities.

7.2.2 Waste transport-TS

In order to ensure cost-effective and rational transport (reduction of the time needed for the collection and reduction of the cost of waste transport) of collected municipal waste, to a “Drisla” sanitary landfill, construction of two transfer stations (in municipality of Shuto Orizari, and municipality of Ilinden) are proposed.

The **basic operating procedure** in each Transfer Station is as follows: The collection trucks, coming from each municipality, enter the TS through the gate and are directed to the weighing area. Then, after the weight measurements, they continue along the paved road to the waste unloading area. The waste collection trucks after appropriate manoeuvres will unload the waste into the appropriate hopper into press containers with capacity of 24 m^3 in order to be compressed. There will be two hoppers in each TS, one for each separate waste stream, mixed residual waste and recyclable waste. When the containers reach their full capacity with the compacted waste, they are then hook lifted onto the truck (for long-distance hauling) and further transported to the CWMF. The total time for unloading and loading of waste is calculated to approximately 45 minutes.

Regarding the green waste stream, it will be transferred in to open containers with capacity of 24 m^3 located in the TS area, without compaction and then transferred to "Drisla" RWMC with hook lift trucks (for long-distance hauling). After unloading is completed, the waste collection trucks are leaving the TS premises via the internal road network.

The Transfer Station facilities will work only in daytime, for 312 days per year.

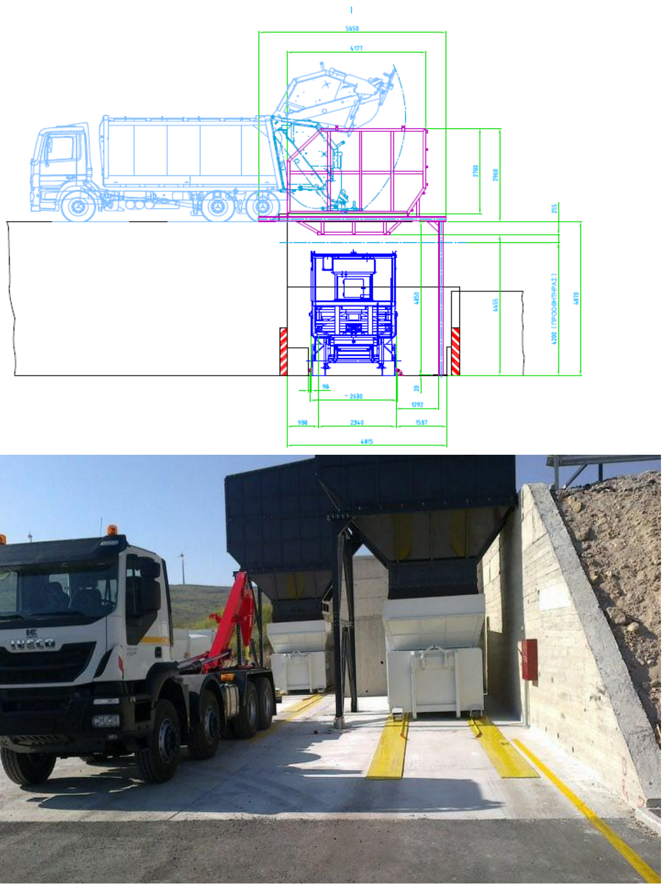


Figure 7-7: Operational unloading procedures at TS

Essential for the **proper function** of the unit is to perform a series of works related to the proper operation and maintenance of all the facilities that make up the unit. Especially the operations and maintenance of facilities include:

a) Maintenance of road.
b) Cleaning of storm water ditches and other storm water management works.
c) Clean the internal road.
d) Maintenance of green areas – irrigation.
e) Maintenance of equipment.
f) Operation - checking and tuning of the facilities at transfer station.

Environmental monitoring works

In order to achieve environmentally acceptable operation of the unit based, it is necessary to perform a series of works related to monitoring - recording and evaluation of a series of parameters related to the main environmental impacts generated by the units. In particular, the environmental works to be performed and the corresponding parameters to be monitored are the following:

a) Checking - monitoring and recording quantity of incoming waste

b) Checking and monitoring proper functioning of entire system and individual sections

c) Recording and processing of meteorological data (optional)

The **Health and Safety measures** are divided into two categories:

a) General safety and hygiene measures that apply in general for industrial facilities or construction sites and waste management projects

b) Specific measures associated with the equipment and functions of TS

The obtained measures of general health and safety work, including the following:

- Training of health and safety regulations (Personnel, users, visitors, etc)
- Provide all necessary means of protection, labour safety and hygiene (filter masks, overalls, boots, booties work gloves operators, protective helmets, reflective vests high definition, reflective waterproof and windproof jacket of high definition, goggles, earplugs, first aid box, stretcher, etc.)
- General safety provisions are required (railings, etc.)
- Personnel training

Regarding the specific security measures associated with equipment and functions of the TS, these consist mainly of the following:

- Protective bar hopper tailings
- All means of protection and automation included in self compacting containers, container rotation system and other durable equipment installation
- All means of protection and automation included in mobile equipment.

Responding to emergencies

The most common emergencies and how to deal with them are:

a) Turn out of large quantities of waste: With spare containers the possible problem is overcome. In the worst case scenario, overtime work will be required by the driver of the transhipment container vehicle.

b) Fire: all appropriate fire protection measures have been taken.

c) Jam of material in the hopper: device is offered with hydraulic release system.

d) Failure of machine: spare parts for emergency incidents are provided. In more serious incidents, the most direct possible damage restoration will be carried out. It is important to notice that under normal maintenance, no damage of the units is expected to occur.

e) Interventions by unauthorized persons: the site will be guarded all the days and hours and therefore no unauthorized persons can enter the TS.

7.2.2.1 Staffing

The proper function of a Transfer Station requires the following tasks to be performed on a daily basis:

- Checking– weighing of incoming waste, particularly:
  - Weigh and record weight of all incoming waste
  - Admission check or not of suspected waste loads to rejection.
  - Updated data on daily - weekly - monthly traffic of vehicles and their waste loads entering the facility.
- Transshipment of waste via the press container.
- Daily transportation from the TS facilities to disposal site (“Drisla” landfill)
- General works operation and maintenance of facilities

The transportation of waste in TS will take place for 312 days per year, and the schedule will be adjusted to transport arrival times of incoming waste, so the unit is operating seamlessly and smoothly.

For all aforementioned works the required personnel analyzed as follows:

Table 7-15: Personnel requirements for TS

Position title	Indicative number of personnel
1. Operations manager	1
2. Weighbridge operator	1
3. General tasksworkers	2
4. Hook- lift truckdrivers	2
Total	***6***

The main tasks of the aforementioned personnel are given below:
a) Operations Manager of the TS, responsible for the overall smooth operation of the TS.
b) Weighing operator: guarding of the unit and weighing of waste within the TS and data recording while performing general duties of organization /cleaning / maintenance.
c) General task workers: responsible for supervising the waste transshipment and performing general duties of organization/cleaning/maintenance.
d) Truck drivers Drivers: for transporting waste from the transfer station to the disposal site

7.2.3MBT, Landfill

7.2.3.1 Mechanical biological treatment - MBT

Despite the efficiency of two bin waste collection system, a considerable part of municipal waste is not collected separately. This waste should be pre-treated prior to disposal in the landfill, and a portion can be processed into fuel and used in a plant for combined production of power and heat. In this way, only the incombustible part is disposed in a landfill. The aims of investing into mechanical-biological waste treatment are: separation of incombustible recyclable waste (metal, glass), utilization of waste which cannot be recycled for energy purposes (light fraction), and finally waste quantity reduction which will be disposed in a landfill (heavy fraction).

Waste treatment plants defined as Mechanical Biological Treatment (MBT) integrate mechanical processing, such as size reduction and air classification, with bioconversion reactors, such as composting or anaerobic digestion. MBT treatment has the aim of reducing, economically and ecologically, the quantity of collected waste that will be disposed in landfills. In mechanical-biological waste treatment, waste volume that is disposed in landfills is reduced to one third of the total waste volume. One third of waste is separated in biological treatment and evaporates, and one third is processed into fuel for thermal treatment. Mechanical-biological waste treatment comprises from the following phases/processes:

- Waste reception;
- Waste shredding or mincing for storage;
- Biological process, i.e., bio-stabilization and bio-drying;
- Mechanical processing and solid fuel production

Biological drying (biodrying) is potential option for the bioconversion reactor within mechanical-biological treatment (MBT) plants. Typically, the biodrying reactor within MBT plants receives shredded unsorted residual MSW and produces a biodried output which undergoes extensive mechanical post-treatment. Biodrying process refers to: (1) the bioconversion reactor within which waste is processed; (2) the physio biochemical process, which takes place within the reactor; and (3) the MBT plants that include a biodrying reactor.

This is attractive for MBT plants established to produce solid recovered fuel (SRF) as their main output, because removing the excessive moisture of the input waste facilitates mechanical processing and improves its potential for thermal recovery.

The stipulated technical model is based on mechanical-biological treatment and comprises biological stabilization/drying and airing of waste and then fuel from waste production (RDF – refuse derived fuel).

7.2.3.2 Landfill

<u>Security</u>

- There needs to be a documented procedure that relates to the management of security throughout the site and the monitoring/maintenance of security infrastructure;
- The Site Manager should be responsible for ensuring that measures installed to prevent unauthorized access are in place and maintained to a satisfactory standard;
- Ensure there is a site notification board and that it contains the correct information as per the permit condition mentioned;
- Introduce a signing in/out system for staff, legal scavengers and visitors that requires everyone to go through the security gate.
- Install and repair the perimeter fencing, as identified in the adjustment plan, and/or install a fence that is difficult to be cut, removed or climbed e.g. galvanized steel slatted fence, during the course of 2011. This will immediately make unauthorized access to the site difficult for both humans and animals and will also ensure that other measures for security in place (e.g. gated entrance, CCTV) are effective at preventing and monitoring unauthorized access to the landfill;
- Ensure the integrity of the perimeter fencing is inspected on a daily basis by the Security Guards on duty and weekly by the Site Manager. The inspection and any actions taken or required to be taken should be recorded on a daily site inspection checklist or site log. These can include but are not

limited to:

- any damage to the fencing, the location of the damage, what measures are required to repair the fencing and actions taken and when this is planned to be done.
- if unauthorized access is suspected, then the Site Manager will attempt to determine how entrance was achieved and any measures that could be put in place to avoid this from recurring.

Waste acceptance

- The waste acceptance procedure document needs to relate to all operations across the entire site, including incineration, and will be required to be extended to composting and sorting once these facilities have been constructed and commissioned.
- The Site Management Team should ensure that all staff are aware of their responsibilities with respect to operation of the site. Therefore, training to ensure these responsibilities are understood needs to be provided to all site operatives. In particular, training should be provided to the weighbridge operators and landfill site operatives including the compactor and bulldozer drivers on all shift patterns. Training needs to be ongoing to ensure the continual understanding of legislation and permit requirements etc. Set up a series of tool box talks aimed at providing the right sort of communication to a range of employees in small quantities.
- All site staff should be made aware of the acceptable categories of waste permitted to be deposited at the site. Training should be provided for staff to enable them to identify non-conforming wastes and ensure that they are aware of procedures required to deal with the wastes, once identified.
- There needs to be a period of induction and a level of competence needs to be shown. It is not possible for one person to know what the requirements of the permit are and the procedures they need to follow in one day. In addition, if the requirements and procedures are not written down then it is difficult for that person to read them through to get a clearer understanding.
- Ensure there is a copy of the permit in the weighbridge office to ensure that it is easily accessible to all who need to have access to it. In addition, once the procedures are written and signed off, a copy of all operational procedures and management plans should also be kept in the weighbridge office.
- Ensure all incoming and outgoing vehicles are logged and the weights of all incoming wastes and outgoing materials are recorded.
- Ensure that there is a quality control system for measuring the tare weights (i.e. weight of unloaded vehicle) in place to keep the records up to date. It is recommended that each vehicle is re-weighed empty at least once every 3 months or after a full maintenance inspection.
- Ensure that the waste composition is also included on the transport and identification sheets to fully demonstrate Level 3 requirements under the Landfill Directive waste acceptance criteria.30
- Wastes, which are not easily verified for compliance by visual means, must not be accepted without the appropriate chemical analysis reports, demonstrating Level 2 requirements for compliance testing.
- All waste must be inspected at the tipping face to ensure it complies with the permit. The compactor operator should be responsible for inspecting each load deposited; however, periodic spot checks should be made by the Site Manager to support this requirement.
- Establish a recording system of any waste that is rejected from the site, stating the date, time, weight, name of company involved and reasons for the rejection. It is also recommended that advice be given to the driver as to how the material can be reasonably disposed of/treated. However, as there is no duty of care in Macedonia and no other legal landfills it is difficult to identify other sites that could take it and it will therefore likely be disposed of in an illegal landfill. By having a method of recording

non- conformances will cover Drisla of any potential liability in the future and provides the MoEPP with an idea as to the quantity/extent of materials that are rejected from the landfill.

- Ensure there is a system for quarantining non-conforming waste that has been tipped at the site and cannot be re-loaded back onto the vehicle. If the deposited waste cannot be reloaded into the delivering vehicle, it should be isolated using marker tape and cones or barriers and suitable covered until appropriate measures can be undertaken to deal with or remove it. Guidance should be sought from the MoEPP in dealing with such incidents. No further waste should be deposited in this area until guidance has been received and the incident dealt with accordingly. Ensure the incident is recorded on an incident log sheet.
- Introduce procedures such that any hazardous waste coming onto site is reloaded and sent away again. In the event of any hazardous waste that could cause immediate safety problems or harm to human health being deposited at the site, the landfill site must be closed and the operational staff and others (e.g. scavengers and site visitors) evacuated from the working area. The MoEPP should be informed immediately and appropriate action taken to remove the waste by means of a specialist contractor operating to the requirements of the Hazardous Waste Directive or local and national Macedonian legislation.
- If there is a lack of capacity or resources at the site to deal with a certain type of waste, whether or not it falls within any of the acceptable categories, the waste in question should be turned away. These may include wastes banned, either by the permit or the Landfill Directive, or those requiring specific disposal, handling or unloading considerations, which cannot be catered for at this site.
- It is recommended that there be a separate section within the Waste Acceptance Procedure for accepting waste at the incinerator and, in time the composting and sorting areas.
- Ensure regular audits of the processes and procedures for waste destruction is undertaken and identify where improvements can be made.
- In the event of uncertainty as to which category a waste falls into, or if a certain waste stream may exceed its annual limit, the advice and prior written approval of the MoEPP will be sought before accepting that waste for disposal. Details of exceedances should be recorded along with incidents of this type.
- The Site Manager should report any occasions where prohibited waste was identified at the site in an incident log book or site daily diary.

Leachate

- Measures should be taken to ensure that rainwater infiltration to the waste is limited and the site manager should review options available to reduce leachate production on a regular basis.
- Once leachate treatment facilities are in place (including leachate recirculation) specific procedures should be developed to review and monitor the processes involved.

Gas

- There is no landfill gas management currently on-site.
- Measures should be taken to ensure that gas control measures are initiated and that the impact from gas is monitored, reviewed and understood.
- Once gas extraction, flaring and utilization facilities are in place specific procedures should be developed to review and monitor the processes involved.

Dust, Mud and Debris

- The Site Manager should be responsible for the control of dust from the site activities and maintain an awareness of the production of dust at all times.

- It is recommended that dust suppression is carried out along the whole length of hard-paved roads (access road as well as the internal haul road), when required.
- Any loads of waste that have been identified as liable to generate dust should be covered with either daily cover materials or other non-dust generating wastes as soon as possible after deposition to limit the potential nuisance.
- If the control of dust on site is deemed to be insufficient by MoEPP and is generating a regular cause for concern, the Site Manager will need to agree monitoring requirements (locations, frequencies and target values) with the regulators.
- The Site Manager should undertake inspections, at least daily but more frequently during times perceived to be higher risk e.g. wet weather, of the access roads and all concreted and paved areas and will consider whether it is necessary to remove any mud and debris found. Any inspections undertaken should be recorded on a daily inspection log and what actions need to be or have been taken to remove the mud and debris.
- The Site Manager should identify any incidents where dust nuisance may have caused to the surrounding environment and/or sensitive receptors and any incidents and actions taken to rectify the problem should be recorded in the daily inspection log.
- The Site Manager should also inspect the wheel wash area to ensure that the correct procedure for washing is generally being followed by the users and provide instructions for use where this is not occurring.

Litter and wind blow materials

- The Site Manager should be responsible for the litter, aerosols and windblown materials at the landfill
- It is important to minimize the potential escape of litter from the site and to maintain the site in a generally tidy state. The Site Manager (or Security Guard during the perimeter inspection) should undertake a daily inspection of the entire site and the immediate surrounding area for the presence of litter. All windblown litter observed by the Site Manager or site operatives outside the boundary of the site should be cleared within 24 hours of it being observed.
- All wastes should be covered with soil at the end of the working day and this material should only be stripped for re-use from an area where tipping operations are going to take place during the next working day.
- Install mobile litter fences and a litter fence on the perimeter fence in the direction of the prevailing wind will help prevent litter and windblown materials from blowing offsite. Mobile litter fences should be constructed around the operational area.
- The Site Manager should assess the location of the mobile screens and get them maneuvered to ensure they are suitably positioned to take consideration of the wind direction, to collect any fugitive windblown litter.
- The litter fences should be cleared and maintained regularly to ensure they remain effective and efficient. Littering fencing should be cleared several times a day during periods of high winds to relieve strain and prevent the fencing from failing.
- The working area needs to be reduced in size and kept small to minimize the amount of litter that can be blown away.
- Litter picking and litter inspections should be recorded in the daily inspection log. Fences should be inspected on a daily basis for litter and maintained in working condition at all times. All inspections

and actions taken should be recorded in the daily inspection log or site diary.

- Drivers entering the site with insecure or un-netted loads may be turned away from the site at the discretion of the Site Manager. Should a vehicle be observed causing a litter nuisance its registration plate should be recorded, if possible, in order to inform the driver.

Aerosols

- The Site Manager should assess any activities that appear to be generating aerosols to determine whether any control measures are necessary.
- A record should be made in the daily inspection log of any measures required or actions undertaken.
- A key source for aerosols generation is in the sprayed recirculation of leachate. Ensure that staff and scavengers are kept away from any areas where recirculation of leachate is occurring
- Consider the need for aerosol masks.
- Provide suitable daily cover.
- Suitable leachate and gas management measures should reduce aerosol production.

Noise and vibration

- Regular noise monitoring should be considered, both on and off-site and at the nearest sensitive receptors (nearest dwellings and site office), to ensure no noise nuisance or impact is generated during the operation of the landfill. The general background noise needs to be established (noise level without any vehicles/equipment running) and the general day to day noise levels monitored in order to allow planning of appropriate control measures/techniques.
- Monitoring should be undertaken during the construction of the new incinerator and infrastructure of the site e.g. installation of the leachate and gas management systems etc.
- Efforts to minimize noise should be considered at all stages of operation from construction through to aftercare.
- Other noise and vibration management may be required at other times for activities associated with the operation that are undertaken at irregular intervals. E.g. bird scaring, drilling, use of temporary pumps.
- The Site Manager should consider whether a particular operation may lead to noise or vibration impacts at the sensitive receptors and should arrange for additional monitoring to the undertaken if necessary.
- Additional monitoring should also be considered if there is a change of operational procedures such as alternative plant and equipment used etc.
- Details of any noise and vibration monitoring identified and undertaken needs to be recorded in the daily log.

Odour

- The Site Manager should maintain an awareness of odor generated at the landfill. It should be noted, however, that the sensitivity of odors generated is lessened with prolonged contact and therefore will not necessarily be easy for site operatives to undertake this role.
- There needs to be a detailed programme of improvement works at the site. This should include the removal and treatment of any leachate ponding at the surface.
- It is recommended that the neutralizing agent, as identified in the adjustment plan, is purchased during 2011 and used when required. If the agent is soluble in water and is applied in the form of a

spray/mist install a misting system around the perimeter of the site closest to the nearest dwellings. When wind is blowing in that particular direction, switch on the misting system and disperse the agent. In time this could be connected to an on-site weather station which will automatically turn on the odor control system when the wind is blowing in a particular direction.

- The tipping face is too large to assist with the control of odors (and other nuisances). The exposed tipping face needs to be greatly reduced so that only a small area is worked on at any one time. This is considered good operational practice and will reduce the impacts of odor.
- Daily cover is not applied at the appropriate rates/times. Daily cover can assist with minimizing a number of nuisances on site e.g. litter, odor etc. The tipping face should be worked on in smaller areas and once 2.5m of waste is deposited then the 30cm daily cover must be applied before moving onto the next area. In some areas the waste has been 10-15m deep before any form of daily cover is applied.
- Consideration should be given to capping the site on completion of tipping to the proposed final contours. A schedule of capping should be developed and implemented to reduce the potential of odor from completed parts of the site.
- Compaction of waste was not observed. Ensure waste is compacted properly as this will assist with minimizing some odors.
- Management should be responsible for ensuring odor is sufficiently controlled on site, for identifying where there may be a heightened risk of odor occurring and for maintaining awareness of odor generated at the landfill.
- Ensure that if there is a heightened risk of odor from a particular activity or waste type then the operatives inform the Site Manager who should instruct them on the appropriate mitigation method.
- Wastes considered to produce a highly offensive odor will be covered with other wastes as soon as practicable after deposition. All waste delivered to the site should be immediately compacted into the waste face.
- The Site Manager should undertake a daily inspection for the odor at the boundary of the site, downwind of the main waste activity and record this in the site inspection log.
- Additional inspections should be undertaken at times when there might be a heightened risk of odor impact as a result of a specific activity being undertaken at the site or if a complaint is made as a result of odor.
- A record should be made of all odor inspection, findings and actions taken or to be taken to mitigate it. The record should also include the atmospheric conditions at the time of the survey.
- If odor is evident then an investigation into the source should be made and steps taken to reduce its impact. All investigations and actions taken should be recorded.

Fires

- The Site Manager should ensure that the fire procedures are followed, but all site operatives need to be aware of their responsibilities in the event of a fire on site. This should be achieved through training and tool box talks.
- There must be a ‘NO SMOKING’ policy at the site with signs posted on the site entrance and at other key locations. This policy must be enforced. Smoking will only be permitted in designated smoking areas. The Drisla Landfill Company needs to consider what action to take should this rule not be abided by, but should consider the potential for expelling people from the site who continually flout the policy.

- Consider a 'contract' between the landfill operators and the scavengers' employers stating what the scavengers can or cannot do on the site and the consequences should they fail to abide by the rules, such as eviction or suspension from site.
- All offices and plant should be fitted with fire-extinguishers and/or smoke alarms. Fire detection is visual so consider using an air horn or other audible signal to make people aware that a fire has broken out.
- The Drisla Landfill Company is responsible for carrying out the tasks for fire protection. The site needs a dedicated named person on site who has overall responsibility and training for fires (and other Health and Safety issues)
- All incidences of fire and actions taken to deal with it should be recorded on the daily inspection log.

Pests, vermin and animals

- The Site Manager should be responsible for the control of flies and other insects at the landfill and when the decision for spraying has been made.
- There needs to be records of the pesticide spraying occurring and who decides why or when the spraying has taken place. Ensure there is a record of inspection and the times, dates and places that spraying has been carried out. It could be included as part of a daily or weekly inspection checklist.
- The site should be inspected at least weekly for the presence of insects during the winter months (1st November to 30th April); more frequently, at least daily, during the summer months (1st May to 31st October), when flies can be a particular problem. Additional inspections should be undertaken especially if there is perceived to be a risk of infestation.
- The inspection and appropriate actions taken should be recoded in a daily inspection log. All incidents of infestations and the actions taken should also be recorded in the site inspection log.
- There should also be a procedure for recording and informing the Site Manager if a Site Operative feels there is a heightened risk or evidence of an insect infestation occurring. The Site Manager should then investigate and, if an infestation is confirmed, the Site Manager should arrange for a suitably qualified/experienced pest control contractor or site trained personnel to take the necessary steps to eradicate the infestation.
- If an infestation has been confirmed then monitoring should take place more frequently until the infestation has been eradicated.
- The site's management team have the responsibility of keeping vermin under control.
- The site should be inspected monthly for the presence of vermin. If it is observed or suspected that there is a presence of vermin, the Site Manager should arrange for a pest control firm or deal with the situation directly on site, to take the necessary steps to deal with the vermin.
- The inspections and any actions taken should be recorded in the daily inspection log.
- Follow up inspections should be undertaken to check whether the bait has been taken.
- The Site Manager should keep a daily record through the site inspections log of any mitigation measures taken as a result of the presence of vermin.
- The Site Manager should be responsible for the control of birds and other scavengers on the site.
- Consideration should be given to the measures that could be employed to scare off the birds and animal scavengers. As a minimum this should include the use of daily cover, as described in other sections of the chapter.

Meteorology

- The Site Manager should be responsible for obtaining weather data and ensuring that this data is available to the MoEPP through the annual environmental report or when requested e.g. during complaints etc.

- Drisla should consider installing their own computerized weather station rather than relying on the local weather forecasts online or through other media. Weather monitoring results could be taken either near to the weighbridge office or the tipping face. The on-site weather station could also be connected to the odor control system so that when the wind is blowing towards the residential areas the odor control system is automatically switched on.
- Any weather station needs to be maintained and calibrated in accordance with manufacturer's instructions.
- The Site Manager should maintain a copy of the daily weather data and should provide this data to the MoEPP or other interested party upon request. It can be included as part of the annual environmental review report.

Maintenance

- Ensure there is a maintenance schedule for all vehicles and a Planned Preventative Maintenance Management Plan is produced detailing the procedures and requirements for this.

Training and Technical Competence

- Article 8 (a) (ii) of the Landfill Directive states that the management of the landfill site must be technically competent to manage the site and that professional and technical development and training of landfill operators and staff must be provided. The Management should be responsible for ensuring that all staff are aware of their role on site, for the potential impacts (both in terms of the environment and health and safety) that could be caused if their role is undertaken incorrectly and for arranging for training to be provided as required.
- In addition, all site staff must be competent to undertake their respective roles and be aware of the impact that their role has on the management of environmental impacts.
- The operator needs to implement a training programme for all employees to ensure that they are fully conversant with their responsibilities for compliance with the soon to be implemented Environmental Management System and the Permit.
- Training needs must be established individually for each employee and records of training should be kept.
- The respective line managers should be responsible for identifying training needs with respect to awareness of and compliance with new or emerging legislation, as well as arranging refresher training.
- A review should be carried out annually to determine whether the needs of the employee have changed and also to identify any additional information that might be required specific to that employee's role on the site.
- All staff roles need to be reviewed annually to ensure that staff are fully aware of any new training requirements and managers are aware of the training and instruction needs of the staff on site.
- In addition, more general training on facility-wide matters should be provided such as emergency procedures and health and safety.
- The site management team will be required to show Technical Competence to operate a non-hazardous landfill of this kind. This qualification is relative to the activities undertaken on the site.

Health and Safety

- The site management team should be responsible for ensuring that adequate precautions are in place prior to major site operations being undertaken; ensuring that all site staff are aware of procedures to be followed in the case of an accident or an emergency; ensuring these procedures are being followed and appropriate action is taken in the event of an emergency occurring and for reporting any incidents to interested parties and those that need to be informed.

- The Site Manager should inspect site operations daily and consider whether any operations being undertaken would be considered unsafe either to site personnel, visitors or to the environment. Issues highlighted will, where necessary, be acted upon immediately and any actions will be recorded in the daily inspection log or site diary. Incidents occurring will be recorded on the daily inspection log.
- Procedures need to be written and communicated to staff to ensure they know what to do in the event of an accident or environmental incident.
- Ensure that ALL staff have the correct personal protection equipment (PPE) for working on the site prior to entering the site. This includes scavengers and visitors if they are required to go on any part of the site.

7.3 Human resources and promoter organisation

7.3.1 Institutional setup and operation of the proposed waste management system

Institutional framework is an essential issue for waste management. Without such a framework can't be function well over the long term. In addition, if waste services are designed to be effective, the authorities must have the capacity and the organizational structure to manage finances and services in an efficient and transparent manner. Different models for institutional framework on country level have been examined and the model which the beneficiary country decided to follow after extensive consultation with the stakeholders, is based on the basic aspect of partial regionalization.

This scenario is the closest to the existing situation. Local PUEs retain the collection and transfer of waste to the TSs or directly to "Drisla" CWMF. This includes collection and transport services up to the Transfer stations, for the municipalities that include Transfer stations, or up to the CWMF "Drisla" for the municipalities which are not foreseen to use Transfer stations. In case of Skopje region, since the Central Waste Management Facility is already established as PPP Company, an InterMunicipal Waste Management Enterprise (IMWME) will manage only the operation of the Transfer stations and basically this role will be assigned to existing PUE "Komunalna Higiena". Transport of all waste from TSs to the "Drisla" CWMF will be in charge PUE "Komunalna Higiena".

Citizens will continue to pay for waste collection and transport services (to the same local PUEs), but they will have to pay an additional fee for the disposal (treatment) of waste, in the future system. Municipalities that are not under PUE "Komunalna Higiena", but deliver their waste to one of the TSs, will have signed a special contract with PUE "Komunalna Higiena" (as a IMWME) under which will be defined the model of payment. Finally, PUE "Komunalna Higiena" (as a IMWME) as well as PUEs that transfer their waste directly to the "Drisla" will pay landfill/treatment fee to this CWMF, accordingly.

Remaining PUEs and the Intermunicipal Waste Management Enterprise will be managed from the Regional Centre (RC). According to the Law on Waste Management (LoWM) (Article 23) competencies of the Regional Centre are:

- Preparing the regional plan
- Proposing projects
- Developing the regional system
- Implementing and managing projects
- Providing contracting services and facilities for handling municipal and other types of non-hazardous waste within regional system
- Coordinating planning and implementing activities
- Provides professional and technical assistance to municipalities for waste management in the preparation of programs and projects for waste management
- Monitor the amount and quality of services rendered within the regional system
- Preparing an annual report of the regional center
- Prepares an annual work program of the Regional Centre

Regional Centers have a clearly defined role in the regional concept of waste management. In practice the RCs are not established yet.

The method of financing Regional Centers is defined in the LoWM, article 123, paragraphs 1 and 4. According to the Law the municipal council may set a fee for waste management in the amount of 1% to 2% of the price for the service for collection and transportation of municipal waste to finance the realization of the goals for waste management set out in the plans and programs of waste management of municipalities, regional plans for waste management, as well as for the financing of regional centers for waste management of at least 40%.Key responsibilities on the municipal level remain the same.

The following table presents a brief overview of the activities within the proposed model

Table 7-16:Overview of the waste management activities in the proposed model

Activity	Local Companies (PUEs)	Regional Enterprise (IMWME)
Waste collection	Yes, current activity	No
Transport of the collected waste to the transfer stations or to the Central Waste Management Facility for those municipalities that will not served from a TS	Yes	No
Waste transport from the transfer station to the regional landfill	No	Yes, new activity
Collection of separate waste at source (recyclables, green waste) and transport to the Transfer stations or to the Central Waste Management Facility for those municipalities that will not served from a TS	Yes, new activity	No
Operation of Transfer Stations	No	Yes, new activity
Waste treatment and disposal on CWMF	No	No

The following diagram illustrates the aforementioned proposed model.

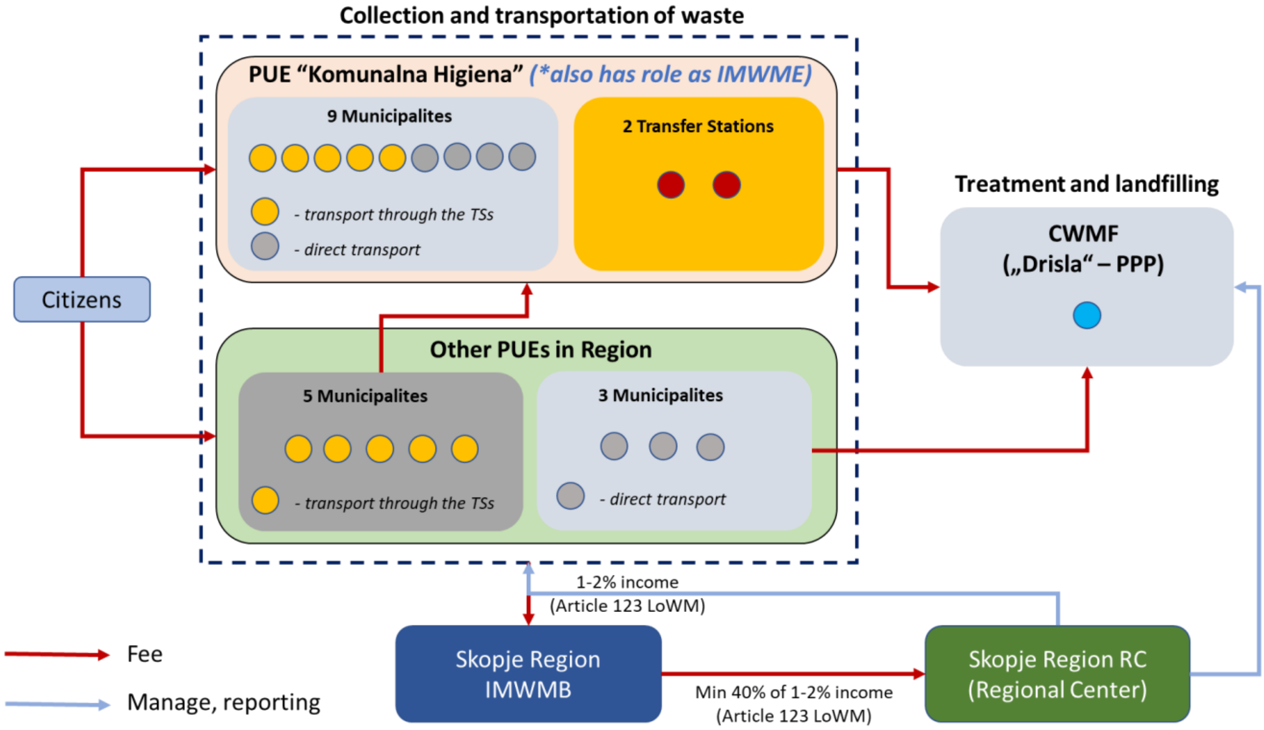


Figure 7-1: Proposed Institutional Model for Skopje Region

7.3.2 Personnel requirements

This section presents the indicative personnel requirements for the intermunicipal waste management enterprise and for the regional center.

Central Administration – Intermunicipal Waste Management Enterprise	
Position title	*Indicative number of personnel*
1. Director	1
2. Assistant Director	1
3. Project Manager	1
4. Head of Engineering projects	1
5. Head of Finance and Accounting	1
6. Etc.	2

Central Administration – Regional Center	
Position title	*Indicative number of personnel*
1. Director	1
2. Secretary	1
3. Board	1

Concerning the personnel requirements of TSs and CWMF these data are presented in the relevant chapters (Chapter 7 and chapter 9 correspondingly).

7.3.5 Training procedures

The theoretical training of staff should be at least for the following areas:

- General information on waste management
- General description of WMC and TS facilities
- Description of the WMC and TS units
- Description of all plant machinery
- Operation manuals of machinery
- Maintenance Manuals - Parts - Analysis of Faults.
- Health and Safety.

In particular the staff training will be done in modules and by groups of workers. The minimum topics given in the following table:

N / A	TRAINING MODULE
1	Legislative framework for waste management
2	Operating Basics CWMF - General education facilities
3	Detailed presentation of flowchart functions
4	Internal Processes – Duties List
5	Hygiene and safety-emergency
6	Administrative operations, financial management and operational costs
7	Fundamentals for equipment maintenance, maintenance schedule, maintenance repairoperations, parts and service equipment
8	Environmental monitoring function laboratory measurements-analyzes and processing results,results database, project monitoring reports
9	Weighing incoming waste and outgoing materials weightings recorded in a database
10	Techniques and landfill operations, cover material, maximizing available space
11	Techniques of Leachate treatment unit-Sampling Techniques - Quality Control - Outputs -Disposal
12	Landfill Equipment - Machinery and Equipment Supporting Equipment-Use of Equipment
13	Monitoring and Maintenance Project (fences, drainage, street cleaning etc) - Management of Vehicle and Personnel - Transfers

Finally, it should be noted that there will be the possibility of holding seminars, educational visits/trips and anything else necessary to further educate and train staff on technology, use and operation of equipment or recovery systems.The administrative bodies of the Intermunicipal Waste Management Enterprise consists of the administrative Board, the Executive Committee and the President. The chairman of the board is elected by the members.

The administrative Board has the following responsibilities:

- Approve the operational plan upon recommendation of the Executive Committee,
- Determines the annual membership contributions of municipalities,
- Approves the financial statements of the enterprise,
- Establish the internal rules and rules of procedure,
- Adopt its internal organization and service
- Consults public authorities or competent bodies upon requesting its opinion.

7.3.6 Competence of the promoter: general competences; project implementation competences

The following figure illustrates the proposed organizational scheme for the new intermunicipal waste management enterprise.

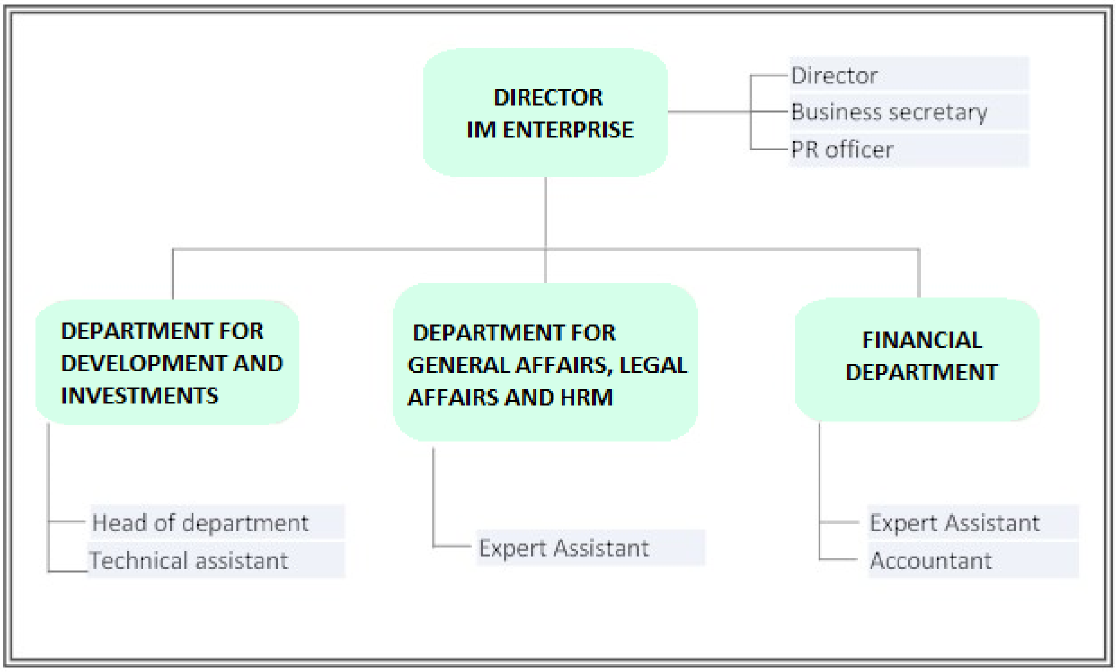


Figure 7-9: Proposed organizational scheme

7.4CAPEX, OPEX and reinvestment cost determination

7.4.1 Waste collection

The following table presents the total investment cost for collection bins.

Table 7-17: Total cost for collection equipment €

No	Item	Unit	Quantities	Unit Cost (€)	Cost (€)
1	**Collection Cost**				
1.1	**Collection Bins**				
1.1.1	1,1 m3 metal bin	item	1,975	341	673,475
1.1.2	1,1 m3 plastic bin	item	7,205	240	1,729,200
1.1.3	120 lt plastic bin	item	1,583	28	44,324
1.1.4	Bins for home composting	item	3,946	39	153,894
			Subtotal 1.1 Collection bins		**2,600,893**
1.2	**Collection trucks**				
1.2.1	RCV, Collection truck 14 m^3	item	16	116,128	1,858,048
1.2.3	Green waste collection tipping truck 6 m^3	item	13	80,594	1,047,722
			Subtotal 1.2 Collection trucks		**2,905,770**
				Subtotal 1: Collection Equipment	**5,506,663**

7.4.2 Waste transport and TS

Table 7-18: Total investment cost for TSs (civil works)

No	Item	Unit	Quantities	Unit Cost (€)	Cost (€)
1	**TRANSFER STATIONS**				
1.1	**TS Shuto Orizari**				
1.1.1	Fence	m	600	48	28,655
1.1.2	Entrance gate	item	1	1,268	1,268
1.1.3	Plateau and roads (incl flood works)	m2	5,825	55	318,503
1.1.4	Administration building	m2	60	500	30,000
1.1.5	Water supply	item	1	8,926	8,926
1.1.6	Sewerage system	item	1	4,825	4,825
1.1.7	Electrical instrallations (lighthing, electricity, phone, fire fighting)	item	1	112,944	112,944
1.1.8	Hopper	item	2	42,613	85,227
1.1.9	Landscaping (incl earthworks)	item	1	57,595	57,595
1.1.10	Weighbridge	item	1	28,000	28,000
1.1.11	Oil separator	item	1	20,450	20,450

				Subtotal 1.1. TS Shuto Orizari	696,393
1.2	TS Gazi Baba - Vardarište				
1.2.1	Fence	m	630	48	30,035
1.2.2	Entrance gate	item	1	1,268	1,268
1.2.3	Plateau and roads (incl flood works)	m2	5,185	51	266,733
1.2.4	Administration building	m2	60	500	30,000
1.2.5	Water supply	item	1	9,748	9,748
1.2.6	Sewerage system	item	1	4,825	4,825
1.2.7	Electrical instrallations (lighthing, electricity, phone, fire fighting)	item	1	109,906	109,906
1.2.8	Hopper	item	2	39,547	79,095
1.2.9	Landscaping (incl earthworks)	item	1	46,537	46,537
1.2.10	Weighbridge	item	1	28,000	28,000
1.2.11	Oil separator	item	1	20,450	20,450
				Subtotal 1.2. TS Gazi Baba - Vardarište	626,597
				Grand Total	1,322,990

Table 7-19: Total investment cost for TSs (mobile equipment)

No	Item	Unit	Quantities	Unit Cost(€)	Cost(€)
1	TRANSFER STATIONS				
1.1	TS Shuto Orizari				
1.1.1	Skid Steer Loader	item	1	30,000	30,000
1.1.2	Press Containers 24 m3	Lump sum	17	23,375	397,375
1.1.3	Open Containers 24 m3	Lump sum	3	7,586	22,758
1.1.4	Hook lift trucks (with crane and cable hoist system)	Lump sum	4	133,118	532,472
1.1.5	Open Containers 7 m3	Lump sum	1	1,550	1,550
				Subtotal 1.1. TS Shuto Orizari	984,155
1.2	TS Gazi Baba - Vardarište				
1.2.1	Skid Steer Loader	item	1	30,000	30,000
1.2.2	Press Containers 24 m3	Lump sum	10	23,375	233,750
1.2.3	Open Containers 24 m3	Lump sum	2	7,586	15,172
1.2.4	Hook lift trucks (with crane and cable hoist system)	Lump sum	2	133,118	266,236
1.2.5	Open Containers 7 m3	Lump sum	1	1,550	1,550
				Subtotal 1.2. TS Gazi Baba - Vardarište	546,708
				Grand Total	1,530,863

8. ENVIRONMENTAL AND SOCIAL ASSESMENT

8.1 Sector legislation, SEA, EI&SA

Strategic Environmental Assessment (SEA) is a planning tool designed to ensure that environmental consequences from the implementation of the planning documents (strategies, plans and programs), and the decisions included within are identified and assessed during preparation and before adoption of the planning documents. SEA improves the information basis for planning, because it gives insight into possible consequences, as well as identifying alternative options and measures that can avoid negative impacts. SEA provides a framework for public debate on the possible approaches in the development of the plan, likely consequences from each alternative and creates legal obligation for the results from the assessment and the debate to be included in the adoption of the plan.

The SEA procedure is prescribed in the Law on Environment (LE) ("Official Gazette of the Republic of Macedonia" No. 53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 44/15 and 39/2016) Chapter X - Assessment of the effects of certain strategies, plans and programs on the environment. Pursuant to Article 65, Paragraph 2 of the LE, when it comes to PDs in the waste management area, the implementation of strategic environmental impact assessment, including impact on human health (strategic assessment) is compulsory.

In addition, the SEA procedure is regulated in a number of bylaws, such as:

- Ordinance on the criteria on the basis of which the decision as to whether a given planning document is likely to have a significant effect on the environment and human health shall be issued ("Official Gazette of the Republic of Macedonia" No. 144/07);
- Ordinance on the strategies, plans and programs, including amendments to such strategies, plans and programs, that are subject to a mandatory procedure for assessment of their impact on the environment and human health ("Official Gazette of the Republic of Macedonia "No. 153/07 and 45/11);
- Ordinance on the content of the report on the strategic environmental assessment ("Official Gazette of the Republic of Macedonia "No. 153/07);
- Ordinance on the public participation in the process of preparation of environmental regulations and other acts as well as environmental plans and programs ("Official Gazette of the Republic of Macedonia "No. 147/08 and 45/11);
- Rulebook on the format, contents and form of the decision for implementation or non-implementation of strategic assessment and the forms for the need for implementation or non-implementation of strategic assessment ("Official Gazette of the Republic of Macedonia "No.122/11);
- Rulebook on the manner of carrying out cross-border consultations ("Official Gazette of the Republic of Macedonia "No. 110/10);

On the basis of the obligations set the Law on Environment (Official Gazette of the Republic of Macedonia

No. 53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 187/13, 42/14, 44/15, 39/16), procedure for strategic environmental assessment (SEA) for the planning document – implementation of procedure for strategic impact assessment from the planning document – Regional Plan for Waste Management for the Skopje region was initiated. In accordance with the obligations, the body in charge for development of the planning document, the Inter-Municipal Waste Management Board for the Skopje region adopted a Decision for conducting Strategic Environmental Assessment for the planning document.

EIA is considered as a project management tool used through the whole process of identification, prediction, evaluation and mitigation of the negative biophysical, social and other environmental effects of development proposals prior to major decision being taken and commitments made. As such, it is used to:

- Identify the potential environmental impacts,
- Examine the nature and significance of environmental implications to all environmental elements,
- Assess whether impacts can be prevented, avoided, mitigated and/or compensated
- Recommend preventive and corrective mitigating measures and monitoring plan,
- Inform all decision makers and concerned parties about the environmental implications and involve them in the whole transparent process
- Advise whether development should go ahead.

Environmental and Social Impact Assessment (EISA) has to include the description of possible alternatives regarding location/traces, possible designs and processes of the planned project. It should answer why the chosen location/trace, design and process are the most appropriate, and to describe it into details. The description, including the impacts and mitigation measures, of all phases of the project, construction phase, commissioning/ decommissioning phase operation and changes of the project, should be described in the EISA. The current state of the surrounding environment, including the environmental medias, social, economical, health and other aspects connected with the people living in the area closed to the project implementation, climate change issues, landscape, geology, hydrology and soils, flora and fauna, material assets and cultural heritage should be described at the study. Possible impacts (positive and negative) of the project to all of these environmental elements should be described, and appropriate mitigation measures for the negative impacts should be foreseen. Transboundary impacts of the project should be also included in the EISA Study. Non-Technical Summary of the Study, intended to approach the planned project and its impacts to the broader public with non-technical phrases should be also included in the EISA Study.

The overall EIA process is regulated by the Law on Environment and several secondary regulations that define the screening and scoping process, the EIA content, the procedure for its evaluation and disclosure as well as adoption / rejection. Macedonian Law on Environment (Article 77) explicitly requires the undertaking of an Environmental Impact Assessment (EIA) on the possible environmental impacts of public and private projects that could significantly impact the environment.

Decree Determining the Projects and the Criteria under which the Requirement for Environmental Impact

Assessment Procedure Performance is Established' (Official Gazette of RM no74/05), prescribes types of projects for which it is mandatory to undergo an EIA.

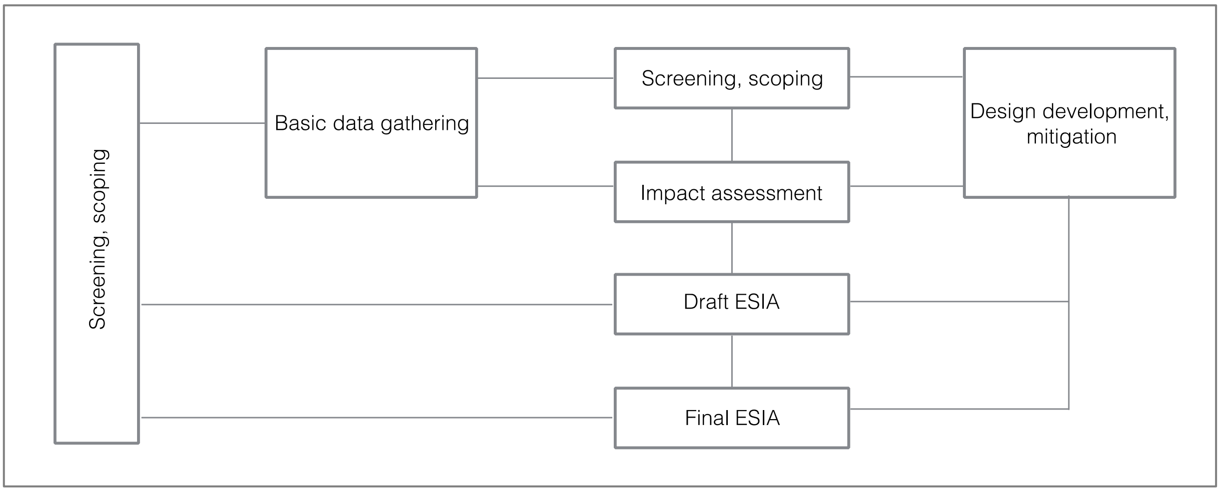


Figure 8-1: Simplified graphical interpretation of ESIA process.

8.2 Baseline Assessment, Environmental and Social Impact Assessment

The proposed project includes construction of the sanitary landfill with associated recovery facilities (mechanical and bio), transfer stations as well as closure of the existing dumpsites/uncontrolled landfills in all the participating municipalities. Each of these infrastructural works might have potential environmental impact. Brief description of these impacts of each of the components of the project. Are given below.

Drisla regional sanitary landfill

The landfill operation might cause the following potential environmental impacts on soil, ground water and surface waters, air, land utilization landscape, traffic and noise, Flora/ fauna/ ecosystems:

Quality of soil, groundwater and surface water could be affected by several streams of wastewater (e.g. technical water generated by: washing of the trucks and the equipment, washing of the service area, etc., as well as sanitary water from toilets, etc.) discharge, leachate and precipitation runoff. Air quality could be affected by dust and gas emitted by the landfill activities. However, landfill gas will be extracted in a controlled manner and utilized for energy generation. Vehicles coming to the landfill and landfill equipment will generate noise, dust and exhaust gases. The construction and use of the landfill will change land usage from forestry/agriculture to landfilling. The existing ecosystem could be influenced by an increased number of insects, rodents and birds scavenging. The landfill construction will change the landscape at the location itself. Existing forest band around the landfill complex will not be removed but additionally expanded.

These environmental impacts will be generated during the landfill construction, operation, closure and re-cultivation. However, construction works, as well as closure and re-cultivation, have minor impact on quality of soil, ground water and surface waters, are expected.

Transfer stations
Transfer stations are open air modalities where municipal solid waste, including demolition waste, will be transferred from small-sized vehicles into large trucks for the purpose of efficient transport to the landfill. Waste can be transported directly from one vehicle to another one or it will be temporary stored at the site. Environmental impacts at the transfer stations site might be the following:

Soil, ground water and surface water: Quality of soil, ground water and surface water could be influenced by wastewater discharge, leachate and precipitation runoff. Air: Air quality could be influenced by dust and gas emissions (odors). Traffic and noise: Traffic around the transfer stations will increase because low-capacity vehicles will bring waste to the transfer stations and large trucks will leave from the transfer stations. This will generate dust, exhaust gas releasing and increase noise level at the location and in its surrounding.

Depending on local situation in every municipality, the land utilization, flora, fauna, ecosystems and landscape could be affected.

Waste separation line
Major activity of the planned waste separation line will be separation of paper, glass, metal, PET, and plastic foil. It could have similar environmental impact as transfer stations. Major benefits of the waste separation line will be decreasing waste quantities, prolonging the landfill lifetime and reusing/recovering secondary raw material from the separated waste fractions. The waste separation line will be located within the regional landfill complex.

Transport
Transport will increase by the implementation of the waste management scheme. Waste from all the municipalities, except Skopje will be transported via longer routes. This additional transport causes the following environmental impact:

Air, traffic, noise: Noise, dust and exhaust gas release will be increased. These might affect people living along the main transport routes, particularly along the landfill access road. Size and complexity of the impact will depend on roads maintenance, roadworthiness of waste transport vehicles and protective vegetative strip between roads and yards as well as on the vehicle maintenance levels. Impacts on soil, ground water and surface water, land utilization, flora, fauna, ecosystems and landscape will not be significant.

Closing of the existing landfills

The existing dumpsites/uncontrolled landfills in the municipalities participating in the landfill scheme will be closed.

The quantity of leachate will decrease over the years and therefore water and soil quality will improve over time. Air quality will improve since there will be a reduction of dust and odors since the sites will be covered, remediated and re-cultivated. Gas emissions will decrease gradually. Traffic and noise: There will be no traffic around the sites anymore and the landfill equipment will not be used any more so noise, dust and gas emissions will stop. Landscape will improve after remediation and vegetation re-cultivation. Land utilization potentials will remain limited due to gas generation and soil settlement. No impacts will be generated on these site and flora and fauna ecosystems will be balanced.

8.3 Implementation of EIA Process

The Environmental Impact Assessment procedure starts when the Investors (Legal entities and natural persons) intending to implement a project are obliged to send a Notification, in written and electronic form on their intention to implement the project to the Ministry of environment and physical planning, more particularly to the Administration for Environment, which is the responsible authority for the entire EIA Procedure. The Administration for Environment is obligated to publish the Notification in at least one daily newspaper available throughout the territory of the Republic of Macedonia, and on the Website of the MoEPP. The Screening procedure is a stage of the Environmental Impact Assessment (EIA) process during which the MoEPP determines whether an EIA should be carried out or not for a certain project. For the development projects that do not belong to the projects for which the EIA procedure has to be carried out there is a procedure where “Environmental Elaborate” should be prepared (according Article 24 of the Law on Environment). The specific content and manner of the screening process where development projects are listed in two groups (List I development projects for which the full EIA procedure should be carried out and List II development projects for which case by case examination should be done in order to identify if the full EIA procedure should be carried out or not).

After screening procedure, the MoEPP informs the Investor by means of decision whether or not an EIA shall be carried out. Based on such information, the Investor applies for environmental impact assessment scoping, which is the next step of the EIA procedure. The decision from the screening has to be published, in at least one daily newspaper available throughout the territory of the Republic of Macedonia, on the web site as well as on the notice board of the MOEPP. The Investor, the legal entities or natural persons concerned, as well as the e-NGOs may lodge an appeal against the decision to the Second Instance Commission of the Government of the Republic of Macedonia responsible for resolution of administrative matters in the area of environment. The Scoping stage is the process during which the MoEPP determines the content and extent of the matters, which should be covered by the environmental impact assessment study (EIA Study). The purpose of the scoping stage and the Scoping Opinion is to inform the Investor of the issues that the final report on EIA Study should respond to.

For the purposes of determining the scope of the study on environmental impact assessment, the MOEPP may authorize persons from the List of Experts. While drafting the opinion on the scope of the environmental impact assessment study, the MoEPP shall take into account the opinions of the Investor and the opinions obtained after publication of the decision for screening. Once scoping is completed the EIA study can be undertaken. The Investor prepares the EIA Study and submits it to the MoEPP in written and electronic form.

The specific content of the EIA study is prescribed in the “Ordinance on the content of the requirements that need to be fulfilled by the study on EIA” (Official Gazette 33/06). The Investor preparing the EIA Study is obliged to engage at least one person from the List of Experts, who shall sign the EIA Study as a responsible person with regard to its quality. The MoEPP announces that the EIA Study on the certain development project has been prepared and is available to the public in at least one daily newspaper, available throughout the territory of the Republic of Macedonia, local radio/TV station, while non-technical report of the study is published on the Website of the MOEPP. This EIA Study is submitted for consultation to the municipality or the City of Skopje on the territory of which the project will be implemented in order to collect their remarks and opinions.

During this stage, the MoEPP is obliged to provide a Public hearing and to ensure availability of information needed to the public and public participation in the public hearing event. The MoEPP submits the Report to the bodies of the state administration responsible for the performance of the activities of the development project. The Review is the process of checking the adequacy of the EIA Study. The Report of the adequacy of the EIA Study is prepared by the MOEPP or by persons appointed thereby from the List of Experts for EIA. The List of EIA Experts was established in the period June-July 2009. The preparation of the Report is carried out on the basis of the EIA Study as well as on the basis of the opinions submitted with regard to the EIA Study. The report states whether the EIA Study fulfils the requirements, proposes the conditions which should be set out in the permit for the project implementation, as well as measures for prevention and reduction of harmful impacts. The specific form, the content, the procedure and the manner of development of the Report of the adequacy of the EIA Study is prescribed in the secondary legislation6. On the basis of the EIA Study, the Report on the adequacy of the EIA Study, the public debate and the opinions obtained, the MoEPP issues a Decision on whether or not to grant consent for the application of the project implementation.

The Decision contains assessment of whether the EIA Study fulfils the requirements, and the permit conditions for the project implementation as well as measures for prevention and reduction of the harmful effects. The MoEPP submits the Decision to the Investor, to the body of the state administration responsible for issuance of permit or decision for the project implementation and to the municipality or the City of Skopje on the territory of which the project would be implemented. The Decision has to be published in at least one daily newspaper available throughout the territory of the Republic of Macedonia, on the web site as well as on the notice board of the MOEPP. Based on the Decision for granting consent for the project implementation, the Authority responsible for issuance of the permit for project implementation, issues the Consent for project implementation.

8.4 Potential environmental impacts, Mitigation Measures, Monitoring and Environmental Action Programme

The Regional Waste Management Plan for the Skopje region is the basis for integrated waste management system in a manner in which the different waste streams created will be controlled, and will also provide directions on handling the waste that will contribute towards:

- Reduction of the waste quantity that ends up in the landfill and poses hazard for the environment and human health;
- Use of the material and energy value of the waste;
- The waste management to be implemented in a manner that will reduce the negative impacts on the environment and the human health;
- Identification of the manner in which the current landfills will be remedied (dumpsites) which are hazardous for the environment and the human health.

The implementation of the preferred scenario S2 is expected to have significant positive impact on the environment and the human health. However, there is probability of negative impacts on the environment. In addition to the identification of the impacts that could occur due to the implementation and operation of the preferred scenario, there will be also positive and negative impacts on the remediation of the dumpsites in the Skopje region. In the table below an overview is given of the main environmental impacts during construction and operation of the landfill. An evaluation is given whether it is sufficiently dealt with or not. This gives a direct overview of the gaps, which need to be dealt with.

Table 8-1: Overview of the main environmental impacts during construction and operational phase of the regional center as potentially most important environmental impact contributor

Associated to activity			Construction phase
Physical environment			
Air pollution	Caused by • Trucks in order to preparelandfill for use • Additional air pollution ofgasses due to replacement of waste • Dust during dry spells	MINOR – no gap	• Use good quality fuel/petrol, well maintained trucks • Take precaution during replacement of waste, includedin the management and contingency plan. • To prevent additional dust, drive slowly and sensibly • Drive slowly to reduce dustpollution to a minimum (no need to spray water)
Noise pollution	Caused by • Trucks in order to prepare landfill for use • Trucks for replacement of waste	MINOR – no gap	• Good maintenance and checkup on vehicles and equipment. Periodic control should takeplace. • Prevent any unnecessary noiseproduction, leaving equipment and vehicles running whilst they are not being used. • Provide ear protection if limits exceed safety standards

Associated to activity			Construction phase
		Physical environment	
Soil pollution	Caused by • Dirty trucks driving in andout during construction phase • Risk of soil pollution during replacement of waste,however keeping the waste where it is will have an evenhigher risk for soil pollution as there is no protectionbetween waste and soil and groundwater.	MINOR – no gap	Good maintenance and checkup on vehicles and equipment. Periodic control should takeplace. • Allow for cleaning and rinsing ofequipment only at a certain place with the right protection toprevent soil pollution. • Regular site inspection to carryout visual checks on oil and chemical spillage duringconstruction.
Water pollution	Groundwater • Potential pollution throughspillage during constructionphase • Indirect through groundwater • Potential pollution ofunderground waters	MINOR – no gap	• All measures need to be takenin order to reduce any spillage of pollutants during constructionphase.
Waste	Caused by • Contractors, waste fromconstruction in general	MINOR	• Waste can be dumped at thesite, unless hazardous waste is produced. It should always be dealt with in accordance withthe local legislation
		Natural environment	
Terrestrial flora & fauna	Negative effect on Flora and Fauna: • Removal of bushes andsmall trees growing atpresent on the site.	MINOR – no gap	Compensation should be madeby planting the same amount of forest in other place.
Aquatic flora & fauna	Possible negative effect onflora and fauna due to pollutionduring construction phasewhich pollutes the river andchannel.	MINOR – nogap	If measures above are taken thenthis effect is minor
		Human environment	
General HSE	During the construction phase, workers are inevitably exposedto hygiene, safety and security risks. The following activities(mainly safety) should have special attention; • Excavation work, • Working with heavymachinery, • Working with chemicals, • Working in very noisy environments (noisy machines),	MINOR – gap	Also for construction phase anextensive HSE management plan should be made. It should includeall relevant aspects (as mentioned in the chapter on HSEmanagement) but for labor protection the following isessential • Provision of PPE (PersonalProtection Equipment), specific for each task, • Permit to work system, regular checks in the field if regulationsand standards are respected, • Provide medical assistance toall workers, • Education of all workers on their risks and

Associated to activity			Construction phase
Physical environment			
	• Lifting and or loading of heavy loads. impact can be classed as minor or major, depending on what will happen in practice. If thecorrect measures are taken and the correct workingatmosphere allows for safe working conditions then theimpact will be minor as it will be as low as reasonably practical(ALARP).		what to do (alsohygiene and illnesses).
Resettlement	Not applicable	NO Impact	No measures needed
People(Roma)	Based on the site visit it is clear that there are some Roma ethnic individuals who earnthere living from waste selection which is sold to recycling companies. During construction the work for these people (about ten intotal) might be made difficult or should be stopped temporarilyfor their own safety	MINOR – no gap	Communication and discussionsshould be made with these people in advance of theconstruction.

Associated to activity			Operational phase
Physical environment			
Air pollution	Caused by • Trucks coming and going withwaste • Normal air pollution from alandfill (methane..etc..) • Additional air pollution ofgasses due to replacement of waste • Dust during dry spells • Additional air pollution caused by traffic due to the closure of the existing landfill site and transport to transfer station and/or Drisla sanitary landfill	MINOR – no gap	• Use good quality fuel/petrol, well maintained trucks • Proper installation of ventilation system for methane gases toescape. There are plans to flare the gasses and use this gas forelectricity production. This is best practice. • Take precaution duringreplacement of waste, included in the management plan and mitigation plan • To prevent additional dust, driveslowly and sensibly • Drive slowly to reduce dustpollution to a minimum (no need to spray water)

Associated to activity			Operational phase
	Closure of the current landfillThe quality of the air will improve as there will be less dust and odour. The escape of methanewill however not immediately stop		
Noise pollution	Caused by • Trucks coming and going with waste • Additional traffic due to the closure of the uncontrolled landfill and transport to transfer station and/or Drisla sanitary landfill Closure of the current landfill No more vehicles will attend the sites and landfill equipment will not operate any longer, so the noise, dust and exhaust gases will disappear.	MINOR – no gap	• Good maintenance and check upon vehicles and equipment. Periodic control should takeplace. • Prevent any unnecessary noiseproduction, leaving equipment and vehicles running whilst theyare not being used. • Provide ear protection if limitsexceed safety standards
Soil pollution	• Possible damage to protection layer (at the bottom of the landfill). Can be discovered bymonitoring of groundwater drainage system. Closure of the current landfill The amount of leachate will decrease, so in time the quality ofsoil and water will improve.	MINOR – no gap	Periodic control should take place. • Allow for cleaning and rinsing of equipment only at a certain placewith the right protection to prevent soil pollution. • Regular site inspection to carry out visual checks on oil and chemical spillage during construction. • If damage is caused this will bedetected by the monitoring system
Water pollution	Groundwater • Possible damage to protection layer (at the bottom of the landfill). Can be discovered by monitoring of groundwater drainage system. Surface water caused by: • Indirect through groundwater Closure of the current landfill The amount of leachate will decrease, so in time the quality ofsoil and water will improve.	MAJOR - gap	• Possibly pump up thisgroundwater at this specific point and pump onto the landfill • If damage is caused this will be detected by the monitoringsystem • It is not clear how the monitoringplan will be carried out, what will be done with water which ispolluted.

	Associated to activity		Operational phase
Waste	Not relevant for operational phase. All domestic waste produced will be dumped on the landfill itself. All water run off willbe treated in the WWTP.	MINOR – no gap	
Terrestrial flora & fauna	Not relevant for operational phase Closure of the current landfill There will be no more traffic which is positive for flora, fauna and ecosystems	MINOR – no gap	
Aquatic flora & fauna	Possible negative effect on flora and fauna due to pollution to soil and groundwater (detected through monitoring of groundwater drainage).	MAJOR	If pollution is detected ingroundwater drainage then this water must be collected andprevented
Human environment			
General HSE	During the operational phase, workers are inevitably exposed to hygiene, safety and security risks. The following activities (mainly safety) should have special attention; • Excavation work, • Working with heavy machinery, • Working with chemicals, • Working in very noisy environments (noisymachines), • Lifting and or loading of heavy loads. Receptors of this impact are the construction workers. The impact can be classed as minor ormajor, depending on what will happen in practice. If the correctmeasures are taken and the correct working atmosphereallows for safe working conditionsthen the impact will be minor as it will be as low as reasonably practical (ALARP).	MINOR – no gap	Also for operational phase anextensive HSE management plan should be made. It should includeall relevant aspects (as mentioned in the chapter on HSEmanagement) but for labour protection the following is essential • Provision of PPE (Personal Protection Equipment), specificfor each task, • Permit to work system, regularchecks in the field if regulations and standards are respected, • Proven qualifications for the work needed, • Provide medical assistance to all workers, • Education of all workers on their risks and what to do (also hygieneand illnesses).

	Associated to activity		Operational phase
Resettlement	Not applicable	NO Impact	No measures needed
People (Roma)	individuals who earn there livingfrom waste selection which is sold to recycling companies. During construction the work for these people (about ten in total)might be made difficult or should be stopped temporarily for theirown safety Closure of the current landfill Will have a negative effect on thepeople living of the landfill from recycling. For inhabitants of the region theclosure will mean less occupational health problemsrelated to the landfill	MINOR – no gap	in advance of the construction.

Monitoring plan during construction and operational phase

Clear monitoring plan for the construction and operational phase for both, landfill and transfer stations need to be defined. A map with the monitoring points needs to be developed as well. It must be stated which parameter should be analyzed at which sampling points and with what frequency. It must be clear what levels are acceptable and unacceptable and what corrective measures are related to the analytical outcome. This should be incorporated in the contingency plan and it must clear who takes the responsibility for action.

The monitoring plan includes daily visual control of:

- Unloaded quantity and kind of waste,
- High-grade extraction and utilization of landfill gas,
- Maintenance of equipment and internal roads,
- Washing and disinfection of transport vehicles,
- Presence and control of pests.

The monitoring plan includes regular sampling and analysis of:

- Quantity and quality of leachate filtrate before and after treatment,
- Wastewater (technical, sanitary) quality after treatment at the sedimentation tank – separator,
- Soil and groundwater quality,

- Air quality outside of the site;
- Gas composition after extraction and separation;
- Determination of the municipal waste morphological composition by the quantities of the separated waste, for the purpose of statistic data on waste separation.
- Geotechnical monitoring of cell construction and stability,
- Monitoring during landfill closure and after-care.

Authorized laboratories must perform quality control of the analytical control procedures and monitoring and/or analyses.

Mitigation measures
The sanitary landfill includes protection measures such as an impermeable liner, top capping and leachate collection and treatment system. It will include precise operational procedures to protect soil ground water and surface water from pollution. In addition, the installation of a landfill gas collection and its utilization system has been foreseen. The following general mitigation measures have been designed for the transfer stations and the material recovery facilities, waste reception facilities and appropriate work procedures. Instructions for cleaning of service area and waste compaction containers are included as well.

Drisla sanitary landfill
Air Protection Measures The main elements of air pollution will be dust particles, gases/odours. The measures to be taken to mitigate impacts of these pollutants, are the following:

a) Prevention of flying-solid particles and their spreading in the environment will be done by proper execution of waste disposal (spreading, compaction and covering by inert material). During summer season, when there is an increased possibility of dust generation, the landfill body will be regularly sprinkled or sprayed from truck-tanks with recycled leachate. Sprinklers will be installed along the landfill periphery.

b) Gases generated due to decomposition of disposed waste (anaerobic decomposition) will be be collected and will be treated to remove harfmul components in a controlled manner at the landfill. Gas collectioin wells will be installed, enabling landfill gas extraction as soon as waste is decomposed (about three years after first waste cells are completed). The landfill gas extraction system will consist of:
- gas collection headers,
- pipe system for gas collection and transport;
- condense water siphons,
- gas combustion in flare (in the first phase of the landfill operation),
- gas utilization in gas engines for electricity generation.

c) Generation and migration of odors will be minimized by daily covering of disposed waste by soil/inert material. A protective vegetation strip will be formed around the landfill complex, which will act as an additional barrier for spreading of odors.

d) Regular cleaning and washing of waste collection/transfer vehicles and the access road.

Soil Protection Measures

a) The landfill will be lined by impermeable liner (e.g., high density polyethylene, HDPE plastic liner) which will prevent leachate from percolating and polluting soil and/or groundwater.

b) Scattering of light waste will be prevented by daily compaction of waste and covering of daily disposed of waste by a layer of compacted inert material. This will also prevent birds and animals from scavenging.

c) The landfill will be surrounded by a fence, of prescribed appearance and height, with car and pedestrian gate at the entrance. It will prevent uncontrolled entrance and prevent animals from entering landfill site.

d) Disinfection and deratisation will be periodically carried out on the site.

e) The protective vegetative strip will be follow the directions of predominant winds to reduce dust, odour and littering. Ground Water Protection Measures a) The landfill bottom will be lined by watertight liner (HDPE), which will prevent leachate generated in the landfill body to spread into the soil and ground water. After collection into a joint collector, or collection manhole, leachate will be conveyed to the wastewater treatment plant.

f) The wastewater treatment plant will be designed to produce effluent in compliance with the required standards.

g) A portion of the treated wastewater will be used for sprinkling of the working surface at the landfill, and the remaining of the treated water, could be transported by truck-tanks to the municipal sanitary sewerage system. Recycling of the leachate is foreseen because of the reduction of the quantity of the leachate by evaporating and reduction of dust on the landfill body.

h) An impermeable liner has been foreseen to be placed on the top of the each filled cassette for the purpose of preventing surface water from penetrating into the landfill body. Surface water will be directly discharged to the surface water collection system (channels) around the landfill.

Noise and Vibrations Measures

a) A high vegetation protective strip around the landfill will prevent the migration of noise and vibration.
b) The equipment planned for operation on the landfill will include a sanitary compactor (equipped with a cabin placed on rubber shock absorbers) which will be air conditioned and will generated low level of noise. Workers working on the site will be provided with adequate noise protection equipment.

Radiation Protection Measures

Disposal of waste with radioactive properties is forbidden.

Measures towards Protection of Human Health

All above-mentioned measures will contribute to the human health protection

Transfer stations

According to national regulations, for each of the planned transfer stations, an Environmental impact study must be prepared. In generally, the locations of the transfer stations have to comply with criteria for site selection and landfill development:

- Manipulation-Service areas at a transfer station have to be built of water impermeable liners,
- Transfer stations have to be fenced appropriately in order to prevent unauthorized people and animals from entering,
- Regular cleaning and washing of the manipulation-service areas,
- Treatment of wastewaters generated by washing and/or handling waste need to be treated before their discharge into the recipient,
- Regular disinfection and deratization of the manipulation-service areas need to be carried out,
- Protective vegetative strip around the fence need to be provided.

MBT

Environmental protection measures for the MBT are similar to protection measures planned for the transfer stations. Additional occupational health and safety measures, which are defined by regulations regarding occupational safety will need to be implemented at the facility. Transport Special compaction containers of adequate size and capacity will transport waste from transfer stations to the landfill site. Modern compaction containers will be used which are constructed to prevent possible leakage. Transfer trucks for transporting compaction containers will be selected which comply with European standards.

Closure of the existing dumpsites/uncontrolled landfills

According to national regulations, the Ministry of Environmental Protection gives approval on projects of uncontrolled landfill remediation and states that the technical documentation needs to be prepared to comply with the Law on Environmental Protection as well as to the relevant laws.

Mitigation measures during the waste transport

At the TS waste will be reloaded into press containers. These needs to be designed to prevent any leakage of the contents inside. This is particularly important in summer when bio-degradation is possible due to high temperatures. The containers have to be reinforced on their sides because waste can freeze in winter time.

Waste transport from the TS to the regional sanitary landfill will go via public roads, the structure of which designed to bear axle load. The access road, which has to be constructed from the public road to the landfill site, has been designed for heavy axle loads. The waste transport trucks need to have labels at visible places at the cabin and the containers, showing what they are used for, the data of the owner address and telephone number.

Regarding gas emission, the waste transport trucks have to comply with the highest EURO standards, as well as with the noise standards.

In case of accident on the public road, it is necessary to do the following:

- If he is not injured, the truck driver will inform his dispatcher of the accident and its location.
- If the truck driver is injured, the police will inform the dispatcher, based on the data labeled on the truck and the container.
- According to necessity, the dispatcher will hire a special vehicle for pulling the damaged vehicle and the container out.
- The waste will be reloaded into the truck with opened container, by special mechanization-vehicles with spoon, and will be transported to landfill.
- Responsible service on territory happen will be contacted to make disinfection of that area to prevent infections.
- Access roads to transfer station will be maintained by local company in the municipality.

8.5 CO_2 footprint calculation

8.5.1 Introduction

Greenhouse gases that can be included within the footprint include the seven gases listed in Kyoto Protocol, namely: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), per fluorocarbons (PFCs), sulphur hexafluoride (SF6) and nitrogen fluoride (NF3). Thefollowing process/activities usually generate GHGs that may be accounted for using themethodologies:

- CO_2-stationary combustion of fossil fuels, indirect use of electricity, oil/gas production andprocessing, flue gas desulphurization (limestone based), aluminum production, iron andsteel production, nitric acid production, ammonia production, adipic acid production,cement production, lime production, glass manufacture, municipal solid waste incineration,transport (mobile combustion).
- CH_4-biomass combustion or decomposition, oil/gas production and processing, coal mining,municipal solid waste landfill, municipal waste water treatment.
- N2O-stationary combustion of fossil fuels/biomass, nitric acid production, adipic acidproduction, municipal solid waste incineration, municipal waste water treatment, transport(mobile combustion).
- HFCs-refrigeration/air conditioning/insulation industry.
- PFCs-aluminium production.
- SF_6-electricity transmission systems, specific electronics industries (e.g. LCD displaymanufacture).
- NF_3-plasma and thermal cleaning of Chemical Vapor Deposition reactors

  Total emissions of these gases are counted in units of CO2 equivalent. The following table presentsexamples of sources of direct GHG emissions by activity type.

Table 8-2: Selected examples of sources of direct GHG emissions by activity type

Activity	GHGType	Potentialsourcesofemission
Combustion forenergy	CO_2, N_2O	EnergyrelatedGHGemissionsfromcombustion: Boilers/ burners/ turbines/ heaters/ furnaces/ incinerators/ kilns/ ovens/ dryers/ engines/ flares/ any otherequipmentormachinerythatusesfuel,includingvehicles.
Combustiongas scrubbers	CO_2	ProcessCO2fromfluegasde-sulphurisation(limestonebased)units
Oil/gasproduction, processingandrefining	CO_2, N_2O, CH_4	EnergyrelatedGHGemissionsfromcombustion:boilers/processheatersandtreaters/ internalcombustionenginesandturbines/catalyticandthermaloxidizers/cokecalcini ngkilns/ firewater pumps/emergencystandbygenerators/ flares/incinerators/ crackers.ProcessrelatedGHGsfrom:hydrogenproductioninstallations/catalytic regeneration(fromcatalyticcrackingandothercatalyticprocesses)/ cokers(flexi-coking,delayedcoking).FugitivelossesofCH4.

Activity	GHGType	Potentialsourcesofemission
Ironandsteelproduction	CO_2, N_2O	Cokeovens:rawmaterials(coalorpetrolcoke)/conventionalfuels(e.g.naturalgas)/processgases (e.g.blastfurnacegas (BFG))/otherfuels/wastegasscrubbing. Metalroasting,sintering orpelletisation: rawmaterials (calcinations of limestone,dolomite carbonatic iron,e.g.$FeCO_3$)/conventionalfuels (naturalgasandcoke)/processgases/process residues used as input material including filtered dust from sintering plant, the converter and theblastfurnace/otherfuels/wastegasscrubbing. Production of pig ironandsteelincluding continuous casting: rawmaterials (calcinations of limestone,dolomite and carbonaticiron,e.g. $FeCO_3$)/conventionalfuels (naturalgas, coaland coke)/reducingagents/processgases/consumptionofgraphiteelectrodes/otherfuels/wastegasscrubbing.
Cementandlime manufacture	CO_2	Calcination of limestone in therawmaterials/conventional fossilkilnsfuels/alternativefossil-based kilnfuelsand rawmaterials/biomass kilnfuels(biomasswastes)/non kiln fuels/organiccarbon contentoflimestoneandshales/ rawmaterialsusedforwaste gasscrubbing
Glassproduction	CO_2	Glassproduction:decomposition of alkali-and earth alkali carbonates during melting of the rawmaterial/conventionalfossilfuels/alternativefossil-based fuelsand rawmaterials/biomass fuels (biomasswastes)/otherfuels/carboncontainingadditivesincluding cokeandcoaldust/waste gasscrubbing.
Paperandpulpmanufacture	CO_2	Pulpandpapermanufacture:powerboilers,gasturbines,andothercombustiondevicesproducing steamorpowerforthemill/recoveryboilersandotherdevicesburningspentpulping liquors/incinerators/limekilnsand calciners/wastegasscrubbing/fossilfuel-fired dryers (suchas infrareddryers).
Aluminiumproduction	CO_2, N_2O	CO_2fromcombustionsources. ProcessrelatedGHGemissions:CO_2fromanodeconsumption/CO_2fromanodeand cathode baking/PFCsfromanodeeffects(orevents).Otherprocess-relatedemissionsthatmay occur, dependingon thefacility configuration,include:$CO_2$from cokecalcinations/SF_6fromuseasacovergas/SF_6fromuse in on-siteelectricalequipment
Nitricacidproduction	**CO_2,N_2O**	CO_2 from combustionsourcesandprocess related.
Ammoniaproduction	**CO_2**	CO_2 from combustionsourcesandprocess related.
Adipicacidproduction	**N_2O**	CO_2 from combustionsourcesandprocess related.
Municipalsolidwaste incineration	**CO_2,N_2O**	GHGsfromMSWcombustion.
Refrigeration/Air conditioning/Insulationindustry	**HFCs**	Fugitive losses of HFCs

Activity	GHGType	Potentialsourcesofemission
Specificelectronics industry(semiconductors,LCD)	**PFCs,NF_3**	Fugitivelossesof PFCsand NF_3.

8.5.2 Project boundaries

The project boundaries defines what is to be included in the calculation of the absolute, baseline and relative emissions. The EIB methodologies use the concept of "scope" as defined by the WRI GHG Protocol 'Corporate Accounting and Reporting Standard', when defining the boundary to be included in the emissions calculation. For the definition of the scope of GHG emissions to be taken into account in a carbon footprint calculation, the literature has generally accepted the approach developed by the WRI/WBCSD GHG Protocol, which differentiated between the following types of emissions:

- Scope 1: Direct GHG emissions. Direct GHG emissions physically occur from sources that are operated by the project within the project boundary. For example emissions produced by industrial processes and by fugitive emissions inside the project boundary. Those are emissions from fuel combustion, process/activity and fugitive emissions.
- Scope 2: Indirect emissions. Scope 2 accounts for GHG emissions from the generation of electricity that is consumed by the project. The indirect emissions, from electricity, heating/cooling usage, are produced outside the project boundary (i.e. at power plant level) but since a project has control over consumption and can improve it with energy efficiency measures, emissions should be allocated to the project.
- Scope 3: Other indirect GHG emissions. Scope 3 emissions are a consequence of the activities of the project but that occur from sources not operated by the project (i.e. indirect emissions outside the control of the operator, such as emissions by suppliers).

According EIB methodology for the assessment of Project GHG emissions and emission variations, only scope 1 and scope 2 GHG emissions of projects are normally included in the footprint exercise.

The following table provides an overview of the scope of GHG emissions produced by differentwaste management activities.

Table 8-3: Scope of GHG emissions produced by different waste management activities

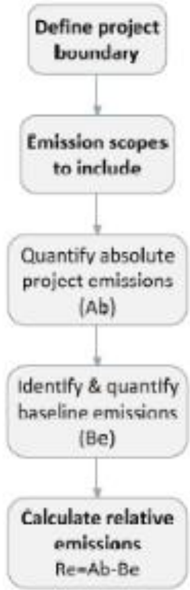
Activity	Net direct GHG emissions (scope 1)	Indirect GHG emissions (scope 2)	Avoided GHG emissions
Material Recovery Facility (MRF)	CO_2 released from fuels consumed in waste collection and transportation to and from the facility	CO_2 from grid electricity consumption	CO_2 avoided through material recovery from waste and recycling
	CO_2 released from fuels consumed in waste collection and transportation to and from the facility		
Biological treatment (composting-	CO_2 released from fuels consumed in waste collection and	CO_2 from grid electricity consumption	CO_2 avoided through energy recovery from

Activity	Net direct GHG emissions (scope 1)	Indirect GHG emissions (scope 2)	Avoided GHG emissions
anaerobic digestion)	transportation to and from the facility CH_4 and N_2O released in anaerobic processes during waste treatment CO_2 released from fuels consumed in waste treatment facility (i.e. by vehicles)		combustion of biogas produced in anaerobic digestion
MBT	CO_2 released from fuels consumed in waste collection and transportation to and from the facility $CH_4$and N_2O released in anaerobic processes during biological treatment CO_2released from fuels consumed in waste treatment facility (i.e. by vehicles)	CO_2 from grid electricity consumption	CO_2 avoided through material recovery from waste and recycling CO_2avoided through energy recovery from incineration of RDF/SRF produced from mixed waste CO_2avoided through energy recovery from combustion of biogas produced in anaerobic digestion
Incineration	CO_2released from fuels consumed in waste collection and transportation to and from the facility CO_2 released in waste incineration (fossil carbon only, biogenic carbon not included) N_2O released in waste incineration CO_2 released from fossil fuels added in waste incineration CO_2 released from other fuels consumed in waste treatment facility (i.e. by vehicles)	$CO_2$from grid electricity consumption	CO_2avoided through energy recovery from incineration of waste
Landfill	CO_2 released from fuels consumption in waste collection and transportation to and from the facility CH_4 released from landfill CO2 released from fuels consumed on the landfill site (i.e. by vehicles)	CO_2 from grid electricity	CO_2 avoided through energy recovery from landfill gas

In the specific project, only the equivalent CO_2 emissions released from fuels consumption in waste collection and transportation have been examined, due to the fact that the CO_2 emissionsreleased from different waste treatment facilities have been included in another PPT contract and are not included in the scope of work of this feasibility study..

8.5.3 Quantification process and methodologies

The following figure illustrates the overall series of activities to quantify the EIB carbon footprint forinvestment projects and the associated relative emissions compared to the baseline.



The EIB Carbon Footprint Methodologies provide a series of emissions factors from which greenhouse gas emissions can be calculated. These have been derived from internationally recognized sources, e.g. WRI/WBCSD GHG Protocol and IPCC Guidelines for National GHG Inventories.

In order to calculate the relative GHG emissions for selected scenario (Scenario 2: two bins collection system with MRF plant, MBT plant and windrow composting plant), a model that developed by Jaspers (this model is mentioned in the document Guide to CBA Analysis of Investment Projects, 2014-2020) regarding waste management facilities has been used. The methodology that has been used for the evaluation of this model is largely compatible with the EIB's Carbon Footprint Methodology (EIB, 2012).

8.5.4 Specific assumptions used for GHG emissions calculation

8.5.4.1 Assumptions regarding GHG emissions from waste collection and transportation

The GHG emissions due to waste collection and transportation depend on the distance travelled by waste collection and transport vehicles, the vehicle type and size of payload. The AEA study provides a simplified method to quantify GHG emissions from collection and transportation of waste, which uses general, fixes assumptions on vehicle types used, payloads and km travelled. The average emission factors that have been used are summarized in the following table.

Table 8-5: Assumptions regarding GHG emission factors for collection and transportation of waste for different treatment options of scenario 2

GHG emission factors for waste collection and transport		
Separately collectedmetal to sorting andrecycling	0.010	t CO_2(eq)/ t recycledmaterial
Separately collectedplastic to sorting andrecycling	0.015	t CO_2(eq)/ t recycledmaterial
Separately collectedpaper/cardboard tosorting and recycling	0.010	t CO_2(eq)/ t recycledmaterial
Separately collectedglass to sorting andrecycling	0.010	t CO_2(eq)/ t recycledmaterial
Separately collectedbiowaste to composting	0.008	t CO_2(eq)/ t recycledmaterial
Mixed Waste to MBT	0.005	t CO_2(eq)/ t recycledmaterial
Mixed waste to landfill	0.007	t CO_2(eq)/ t recycledmaterial

8.5.5 Results from GHG emission calculations

8.5.5.1 GHG emission calculations in without project scenario

The following table summarizes the net average GHG emissions, in t CO_2(eq), for the different components of the waste management system in the baseline (without-project) scenario.

Table 8-9: GHG emissions, avoided GHG emissions and Net GHG emissions (average 2021-2046), in tCO2(eq) in without project scenario

WITHOUT PROJECT SCENARIO	
Mixed Waste from Households	
GHG emissions from waste collection and transport (t CO_2(eq))	1,284

8.5.5.2 GHG emission calculations in with project scenario

The following table summarizes the net average GHG emissions, in t CO_2 (eq), for the different components of the waste management system in the with-project scenario.

Table 8-10: GHG emissions, avoided GHG emissions and Net GHG emissions (average 2021-2046), in tCO_2(eq) in with project scenario

WITH PROJECT SCENARIO	
Mixed Waste from Households	
GHG emissions from waste collection and transport (t CO_2(eq))	1,179

8.5.5.3 GHG emissions-Incremental calculations

Incremental GHG emissions can be calculated if we subtract the GHG emissions in with project scenario from GHG emissions without project scenario.

The following table presents the incremental GHG emissions for the different components of the waste management system.

Table 8-11: Incremental Approach

INCREMENTAL APPROACH	
Mixed Waste from Households	
GHG emissions from waste collection and transport (t CO_2(eq))	-105

8.6 Climate Change adaptation / resilience

8.6.1 Background on Climate change

The increase in global surface temperature is the most obvious aspect of anthropogenic climate change. In case the future greenhouse gas emissions remain at current levels or increase, further warming up would appear and it will start many changes within the global climate system, probably even larger ones than it was observed in the 20th century. The average temperature for the European land area for the last decade (2002-2011) is 1.3°C above the pre-industrial average, which makes the increase over Europe faster than the global average. Moreover, significant economic losses and human facilities associated with extreme weather events, such as heat waves, droughts and heavy precipitation, have been registered.

Even small climatic changes can have significant implications. The hot summer of 2003 across Europe was a 1 in 500 year event. It led to more than 35,000 deaths and economic impacts in many countries. By 2040, due to rising temperatures, this is expected to be a 1 in 2 year event.Projected changes in temperature and precipitation across the EU region in the coming decades are shown in the following figures. The key points can be summarized as follows:

- Wintertime temperature increases are expected to be greater in north-east Europe (+2.5-3.0 °C by the 2050s) than in south-west.
- Summertime temperatures may increase in south Europe by up to 2.5°C by the 2050s. Given that these countries already experience some of the hottest summer temperatures in the region, these increases are expected to have detrimental impacts on many most industry sectors, the environment and society.
- Average winter precipitation is projected to increase in Europe. Some countries in northern Europe may see in excess of 25% increase by the 2050s. However, some in southern Europe are more likely to experience decreases, with consequential impacts on water users.
- Average summer precipitation is projected to decrease generally in southern Europe, with some countries projected to see decreases of up to 50% by the 2050s. Couples with higher summer temperatures this could lead to increased water stress, impacting particularlyon high water use sectors.

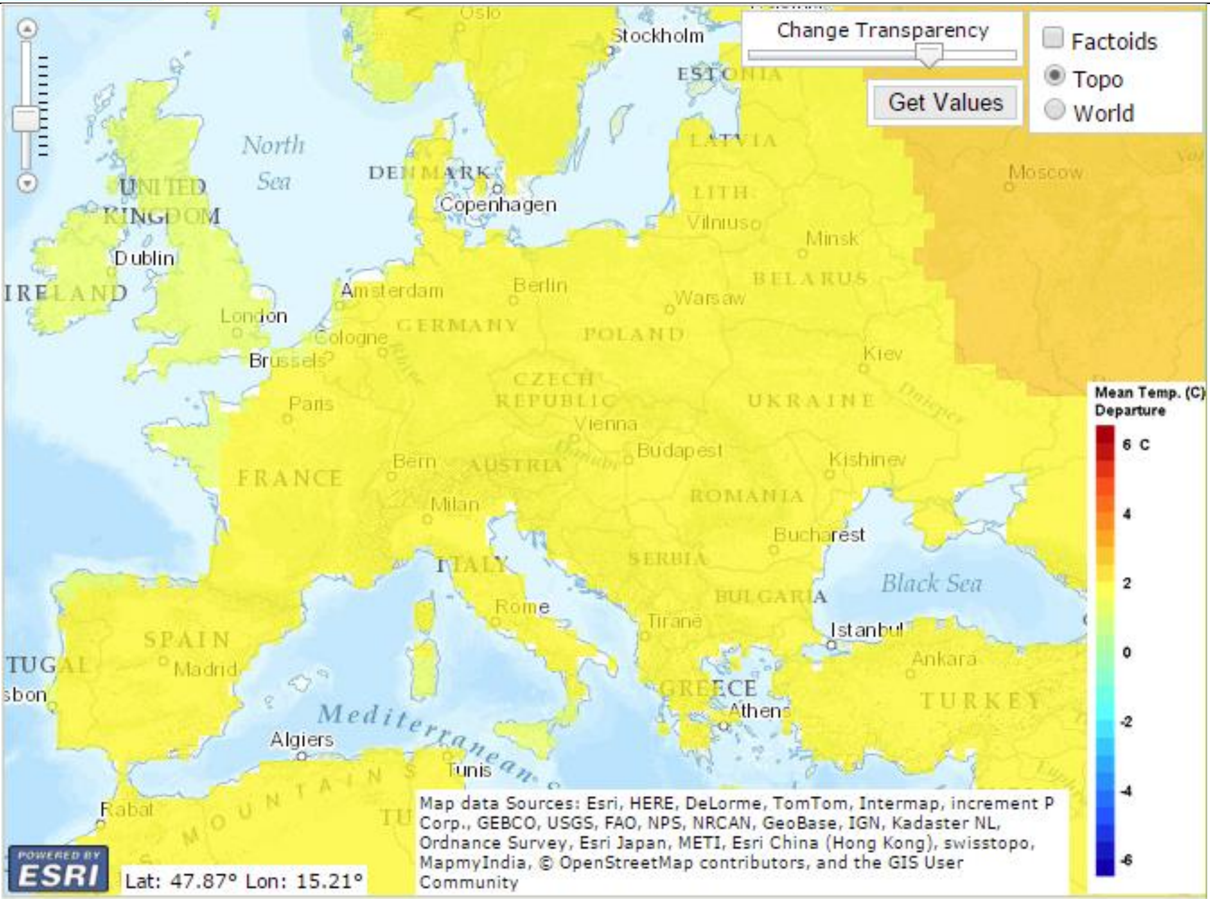


Figure 8-2: Temperature change projected by the middle model as compared to the 1961-1990 baseline average

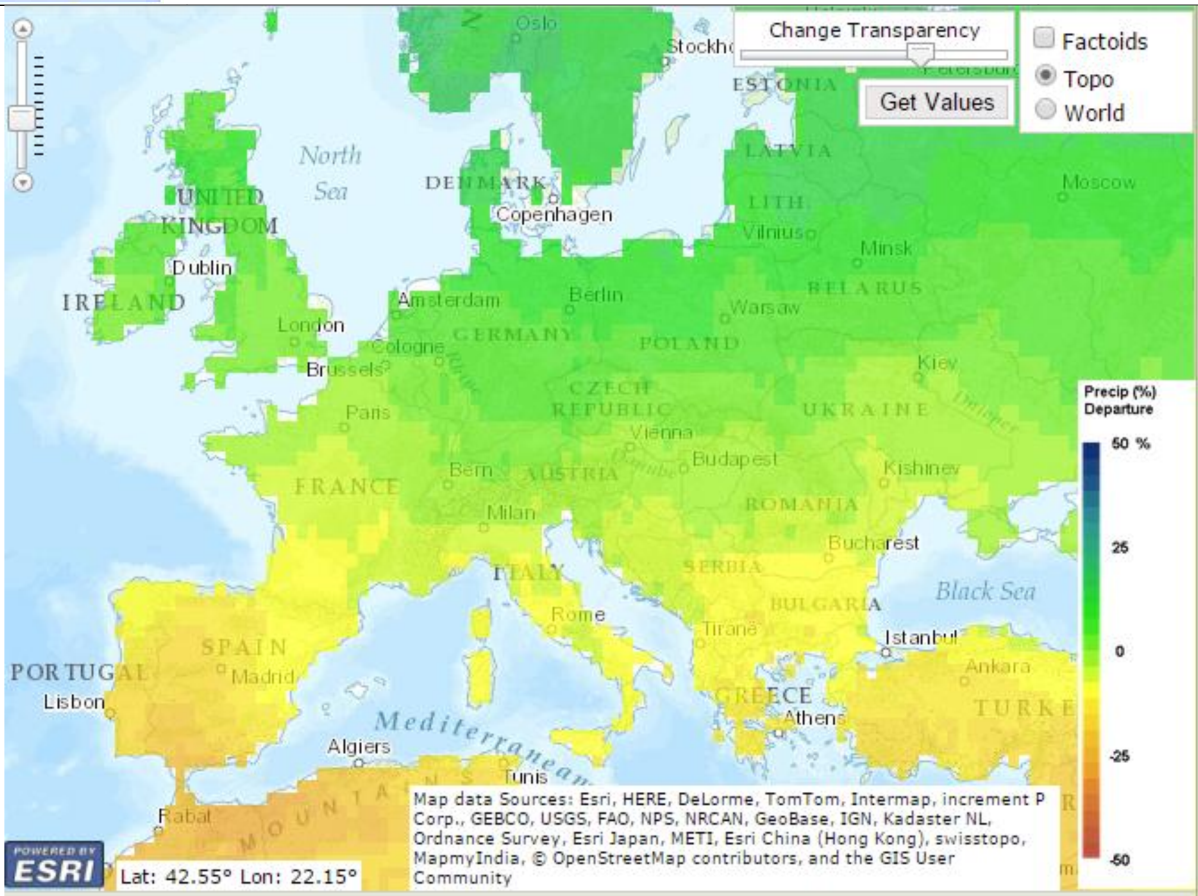


Figure 8-3: Precipitation change projected by the middle model as compared to the 1961-1990 baseline average

Climate stressors can impact solid waste facilities both directly and indirectly. For example, while higher temperatures may directly alter decomposition rates, climate change may also affect access to roads, ports and energy, indirectly liming the collection of waste and operation of waste management sites.

Flooding poses the biggest threat to solid waste infrastructure. Without proper water catchment systems around a landfill, heavy rain events can degrade the landfill, causing breaks in the containment structure that allow debris and leachate to escape from the landfill and contaminate local resources. Flooding from extreme storms may undermine landfill foundations, releasing leachate into groundwater or block collection routes, sweep waste into waterways, and cause waste to clog other infrastructure. Landfills near the coast or in low-lying areas are vulnerable to sea level rise and storm surge. Water infiltration of the pit can lead to an overflow of waste from the landfill. Saltwater infiltration from below can deteriorate the impermeable lining of sanitary landfill facilities.Temperature increases may necessitate more frequent waste collection schedules and rigorous landfill management practices, as odours will be stronger. Higher temperatures and drought may also increase the risks of fire at waste facilities. These and other climate change risks vary in relative importance, with a range of cost implications, compounding effects and impacts on development objectives.

8.6.2 Observed Climate Change in the beneficiary country

Detection of climate variations and changes in air temperature and precipitation over the area of the beneficiary country since the beginning of the 20th century has been performed according to the long-term meteorological measurements that started during the 19th century at meteorological stations in different climate regions, data extracting from the hydrometeorological institute of the beneficiary country (Ristevski P. et al - Estimation of Climate Change Impacts in Republic of Macedonia, http://www.meteo.gov.mk/). Characteristics of the changes of temperatures and precipitation are shown for 5 meteorological stations of Republic of Macedonia (Skopje, Bitola, Prilep, Stip and Demir Kapija) for annual values for January and July values for the period from 1926 to 2000. It means that the only data for region with continental-sub-Mediterranean climate are available, as well as region with hot continental climate.

Air temperature

Changes in thermic regime of the air in the period from 1926 to 2000 during January are rapid changeable values and in the period from 1926 to 1938 are over average ones. The hottest period occurred in the period from 1970 to 1972 when air temperatures were measured and on appropriate way leveled and which are in the limits between 4.1 °C in Skopje and Bitola, 3.8 °C in Prilep, 5.3 °C in Stip to 6.1 °C in Demir Kapija. The lowest values were recorded 1942 (-6.6 °C in Bitola and Prilep, -6.7 °C in Skopje, -4.5 °C in Stip and -4.6 °C in Demir Kapija), 1975 (-7.7 °C in Bitola and -4.8 °C in Prilep), 1993 (-7.2 °C in Bitola and -4.9 °C in Prilep) and in January 2000 (-6.8 °C in Bitola and -5.4 °C in Prilep).

During July greater stabilities of the values appeared where the higher values than average ones appeared in the period from 1926 to 1964 and from that time determined decreasing of temperatures began in that month which last to 1988 when the maximum appeared which is between 25.6 °C in Bitola to 25.7 °C in Prilep, 27.1 °C in Stip, 28.2 °C in Demir Kapija to 27.0 °C in Skopje. The lowest value of long cold period appeared 1976 when average air temperature was 19.8 °C in Bitola and Prilep, 21.4 °C in Stip, 22.8 °C in Demir Kapija to 21.3 °C in Skopje.

The hotter years in 20th century happened in Republic of Macedonia in the period of the beginnings of the analysis (1926) to 1966 when period with determined decreasing of air temperature began and lasted to 1991. From that period determined trend of increasing of annual air temperature has appeared. The lowest value of air temperature appeared 1975 when the following annual values were recorded: 10.1 °C in Bitola, 10.6 °C in Prilep, 12.6 °C in Stip, 13.0 °C in Demir Kapija to 12.0 °C in Skopje.

Precipitation

Changes in precipitation in Republic of Macedonia are investigated also for the five above mentioned meteorological stations: Bitola, Skopje, Prilep, Shtip and Demir Kapija for the annual values for the most precipitative months: November and May as well as for the driest month in Republic of Macedonia (August).On the basis of annual sums of precipitation common trend of decreasing of precipitation can be remarked especially from 1984 which are more expressive in the eastern parts of Republic of Macedonia. The common decreasing of precipitation occurred at May precipitation especially from 1980 (for example in Prilep and Stip) as well as at November precipitation in the period from 1984 until now. August monthly sums of precipitation are very changeable values and they vary from year to year at each station. The change of precipitation in Bitola and Prilep is characteristic.

The most characteristic dry period was between 1984 and 1994. According to the report "Third National Communication on Climate Change" an analysis was made of the variability of key climate elements (air temperature, precipitation, solar radiation etc) in the country for the period from 1926 to 2012. Data for this period were collected at the meteorological stations in Skopje, Shtip, Bitola, Prilep and Demir Kapija. These metering station with shorter data series in the country. Experts also analysed the period from 1951 to 2012 with data collected at metering stations with shorter data series in Lazaropole, Ohrid, Prilep, Berovo, Kriva Palanka, Gevgelija and Strimica. Were also analysed individually (Source: www.unfccc.org.mk).Comparisons were based on three 30-year series, and the periods from 1971 to 2000 and from 1981 to 2010 were compared with the period from 1961 to 1990. Decade values for the periods from 1931 to 2010 were also compared with the period from 1961 to 1990.

Air Temperature

Analysis of the multi-year variation of the mean annual temperature shows that in the 1950 decade, relatively higher air temperatures were measured in all meteorological stations on the whole territory of the beneficiary country. After this period, there was a relatively colder 20-year period (1971-1993), while in the most recent 20 years (1994-2012) the mean annual temperature has been constantly higher than the multi – year average. The multi – year variation of the average annual air temperature during this 87 – year period given in the table below.

Table 8-12: Temperatures at various meteorological stations

Station	Multi-year variation of average annual air temperature for the period 1926 to 2012	Average mean annual temperature for the period 1961-1990	The difference in the average annual air temperature for the whole period (1926-2012) compared to the average annual temperature for the period between 1961 and 1990
Bitola	10.1°C and 13.2°C	11.0°C	0.4°C
Skopje	10.8°C to 14.3°C	12.1°C	0.3°C
Shtip	11.2°C to 14.3°C	12.6°C	0.4°C
Prilep	10.1°C to 14.3°C	11.1°C	0.3°C

The warmest years recorded on the territory of the country for the period between 1951 and 2012 and for which data from all meteorological stations are available are 1952, 1994, 2007, 2008 and 2010. Among the ten warmest years from the period 1951-2012, five of the last six most recent years are included (2007, 2008, 2009, 2010 and 2012). The highest maximum air temperatures in the country in most of the meteorological stations were measured on july 24, 2007. At the meteorological station in Demir Kapija, unprecedented 45.7oC was measured, which is the highest air temperature ever measured on the territory since the beginning of meteorological measurement. The highest mean monthly temperatures in July were measured in 1988, 2007 and 2012.

The five coldest years measured in almost all meteorological station are 1973, 1976, 1980, 1983 and 1991. The lowest value of the minimum air temperature on the territory of the country is - 30.4oC and it was measure on January 7, 1993 in Bitola.General conclusion that can be reached based on the analysis is that the periods from 1971 to 2000 and from 1981 to 2010 are warmer compared to the period from 1961 to 1990. According to the following figure, the most recent thirty years period (1981 – 2010) is the warmest, and the differences in the average mean annual temperature in comparison with the the period from 1961 to 1990 range from 0.2oC to 0.5oC. This increase in the temperature is consistent with the results from reports from the broader region.

Figure 8-4: Average air temperature. Deviation of the average of two periods 1971-2000 and 1981-2010 from the 1961-1990 period

A similar analysis of precipitation for the different regions of the country by years and by seasons with special focus on May and November as the months with the most rainfall throughout the year indicated a general trend of decrease in rainfall. However, due to the fluctuations in levels of precipitation from year to year, it is difficult to establish the exact amount of this decrease in annual precipitation totals.

The quantity of total annual precipitation for the period 1971-2000 and the period 1981 – 2010 at all meteorological stations in the county is lower than for the period 1961-1990 with the exception of the meteorological station in Bitola. The following figure indicates the less precipitation at most meteorological stations during the 1971-2000 period compared to the other two periods.

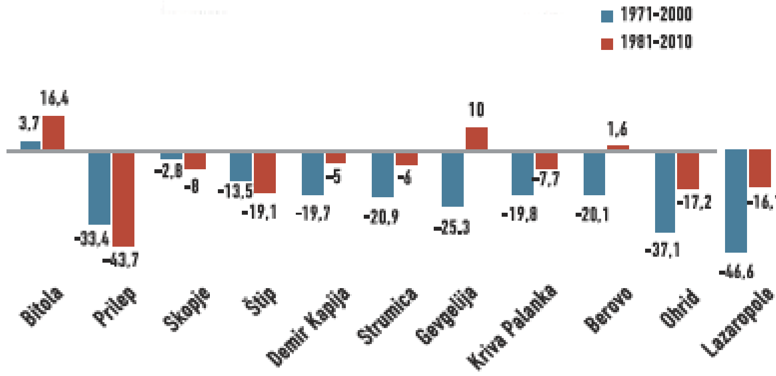


Figure 8-5: Total average precipitation. Deviation of the thirty year average in two periods 1971 – 2000 and 1981 – 2010 from the 1961 – 1990 period.

Annual reduction in precipitation are expressed most strongly at the meteorological stations in Prilep, Ohrid and Lazaropole. Changes in precipitation by months and by seasons vary. A higher decrease in precipitation across the country has been observed in spring. In all stations in autumn and in some stations in summer there is an increase in the precipitation in the two periods from 1971 to 2000 and from 1981 to 2010.

Extreme temperatures

This section presents analysis of extreme air temperature conditions recorded in the beneficiary country, including the occurrence of the heat waves and cold waves, tropical and summer days, and frost and ice days. Daily maximum and minimum air temperatures were taken from statistics from 11 main meteorological stations for period from 1961 to 2012. Researchers paid special attention to Skopje, Stip and Bitola (as the most representative stations for the main climate regions) and at (Strumica, Demir Kapija and Gevgelija (as representative stations for the southeast region, the most vulnerable to climate change). On the basis of maximum daily air temperature values, it was concluded that the frequency of heat waves decreases in correlation to the length of their duration, with the most frequently occurring heat waves being those of the shortest duration.

Researchers also found that the total number of recorded waves was unevenly distributed over time. Increases in frequency were also observed in various cities. In contrast to the period 1961- 1987, a heat wave is recorded almost every year starting in 1987. It can also be noted that the greatest frequency of heat waves has occurred in the last ten years, with maximum occurrences at the greatest number of stations in 2012 and 2007. During 2012, 10 heat waves were recorded in Kriva Palanka, 8 in Skopje, Stip, Lazaropole and Demir Kapija, 7 in Gevgelija and Berovo, 6 in Bitola, 5 in Strumica and Prilep and 3 in Ohrid.

The following figure shows the number of summer days by years recorded the five main meteorological stations for the period 1961 to 2012 illustrating that the number of summer days has significantly increased in recent years as compared to the number at the beginning of the analysed period. Similarly there has been a significant increase in the number of tropical nights in recent years.

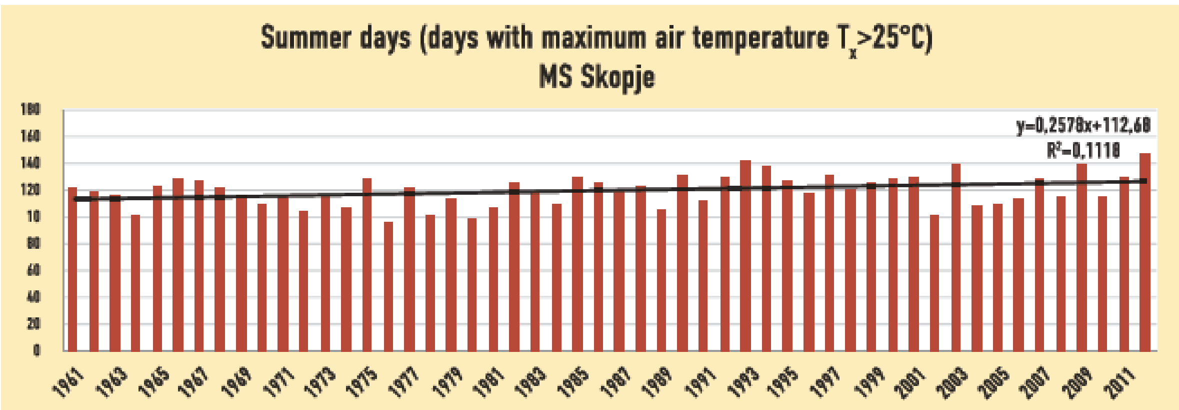


Figure 8-6: Summer days (days with a maximum air temperature of Tx>25oC in Selected areas for the period 1961 – 2012

8.6.3 Climate changes in the 21st century

In this paragraph information and data extracted from the report "Third National Communication on Climate Change". (Source: http://www.unfccc.org.mk/Default.aspx?LCID=207).The climate change projections developed for the beneficiary country as part of the preparation of the Third National Communication were carried out with the help of the MAGICC/SCENGEN software package. Most climate projections use storylines and the associated emissions scenarios published by the IPCC in 2000 in the Special Report on Emissions Scenarios (SRES) (Nakicenovic and Swart, 2000).

The SRES emission scenarios are organized into families, which contain scenarios that are based in similar assumptions regarding demographic, economic and technological development. The six families of emissions scenarios discussed in the IPCC's Third Assessment Report (TAR) and Fourth Assessment Report (AR4) are A1F1 ("fossil intensive"), A1B ("base"), A1T ("technology"), A2, B1 and B2.Furthermore an assessment of air temperature and precipitation changes has been made for the period 2025-2100, comparing these changes to those in the period 1961-1990, which was chosen as a point of reference. In accordance with the recommendations of the software for removinginter-annual fluctuations and indeterminacies, the results obtained represent a mean state forthe thirty-year period, with the central year selected to represent the period. Assessments weremade for four characteristics years:

- 2025, the central year for the period 2011-2040
- 2050, the central year for the period 2036-2065
- 2075, the central year for the period 2061-2090
- 2100, representing the central year for the period 2086-2100

Data from the 18 models were used in the estimation, generating complete results suitable forfurther use. Results were generated for two central points: A (41.25° N, 21.25° E) and B (41.25°N, 23.75° E). Data generated at point A are valid for the largest part of the territory while thedata generated at point B are only valid for the eastern part. Scenarios were generated for thefour characteristic years, for each central point, for each of the three values of climate sensitivityand for each of the six scenarios. Values were produced for air temperature and precipitationchanges as follows: for twelve months from January to December and for four seasonal periods.The values obtained for changes in air temperature and precipitation for each year are averagedfor the three values of climate sensitivity and for each scenario.

Air temperature

The following table shows the mean air temperature changes at central point A. All of the valuespresented are positive, meaning that an increase in air temperature is predicted in the period2025-2100. Temperature changes are given below. The data indicate an increase in airtemperature throughout the whole period 2025-2100. These changes are greatest in thesummer period. The changes marked with "high" and "medium high" have the highest gradientof increase (for the period between 2025 and 2100). The changes marked with "low" are developmore moderately.

An examination of the highest, medium and lowest changes predicted for the mean monthly airtemperature for central point A, per month and per year for 2025, 2050, 2075, and 2100revealed the following:

- For all the selected years, all changes in air temperature are positive, meaning anincrease in mean monthly temperatures
- The intensity of changes is greatest in the warmest period of the year from the May toOctober, when a significant difference appears in temperature changes betweenadjacent months.
- Inter-monthly changes in air temperature are more moderate in the coldest period ofthe year from November to April.
- In July there is a primary and in February a secondary (almost twice as small) maximumof changes
- In April there is a primary and in December a secondary (almost twice as small) minimumof changes.
- The greater changes in temperature predicted in February in comparison to the changesin March and April indicate a possible levelling of the average monthly temperatures inthis period.

An analysis of quarterly changes shown in the model for point A led to the following additional conclusions:

- It is probable that there will be a continuous increase in temperature in the period 2025-2100
- Compared with the period 1961-1990, the predicted changes for the period 2025-2100will be most intense in the warmest period of the year. Thus summers will be warmerand warmer, and the rise in temperature greater. The air temperature is also expectedto increase, through with less intensity, in the coldest period of the year.
- It is possible that the average monthly temperatures at the winter into spring will belevelled in this period.

A similar process was used to determine results for central point B in order to describe changesin air temperature and precipitation in the easternmost part of the country. The analysis madefor the results at point A were also valid for the results at point B, with the exception of minordifferences in the change values. Although these differences between predicted air temperaturechanges at central point A and central B appear slight, they range from -0.3$_0$C to 0.2$_0$C. Thedifferences indicate the influence of local geographic situations on climate conditions andchanges. Nevertheless, these differences are not so dramatic to require significantly differentmeasures to be taken for adaptation to climate change and mitigation related to increasedaverage air temperature in the future for points A and B. For the whole territory of thebeneficiary country, only the results generated from central point A (which is representative ofalmost three quarters of the country) could be used with a great certainty.

Precipitation

The above table indicates, all values are negative. This means that a decrease in precipitation ispredicted in the period 2025-2100. In all seasons and the annual level there is a decrease ofprecipitation quantities, with the maximum decrease in the summer season. The followingconclusions can be drawn from the data:

- For all selected years, all precipitation changes are negative. (This means a decrease inmean precipitation sums)
- In areas with high levels of change, there is only one insignificant increase inprecipitation (1%) in February (in 2015).
- In the areas with low changes, there is an increase in precipitation in February for allyears (up to 5%), in April (for 2025), and in July and November for 2025.
- In the areas of medium changes there is a slight (up to 3%) increase in precipitation forall years in February for 2025
- The intensity of changes is greatest in the warm part of the year. In July and August, theintensity of changes may reach 100%, meaning these months will probably have noprecipitation at all
- In the cold period of the year, decreases in precipitation of up to 40% of the averagemonthly quantities are predicted.

An analysis of the data by season produced the following findings and conclusions:

- A decrease in average precipitation quantity
- For all years (2025-2100) there is a maximum decrease in precipitation in summer (June,July and August)
- In summer the precipitation decrease will be greater and faster than in other seasons
- Decreases will be more moderate in the cold part of the year
- It is probable that there will be a continuous decrease in the quantity of precipitation inthe period 2025-2100

- The predicted changes will be most intense in the warm part of the year, meaningsummers will be drier and some summers months (July and August) may have noprecipitation. (In the previous period with archived data, some months were alsorecorded as having had no precipitation)
- A less intense decrease in precipitation is expected in the cold part of the year

The results for Central point B describe the change in the quantity of precipitation in the easternmost part of the territory. The analysis carried out of results for Central Point A is also valid forresults in Central Point B, with the exception of a slight difference in the changes. Although thesedifferences are slight (less than 1%), the data indicate that there will probably be a greaterdecrease in precipitation in the parts of the territory covered by point A than in the easternmostpart. In the other part of the year, the difference between changes in Central point A and CentralPoint B range from +1% to -6%. This indicates greater decrease in precipitation in the easternparts of the country in the warmer part of the year, especially in summer, than in any other partof the territory. These differences are indicative of the influence of the local geographicalsituation on climate conditions and changes. However they are not dramatic and generally donot require significantly different measures and activities to adapt and mitigate climate change.

This means that the results generated for Central Point A, which covers almost three quarters ofthe territory, could be used with great certainty for the whole territory of the Republic ofMacedonia.In general, the characteristics of projected changes in air temperature and precipitation for theperiod of study were as follows:

- Changes are predicted throughout the whole 2025-2100 period, and an increase intemperature is probable
- The temperature increase will be most intensive and significantly in the summer, andsummer will probably be increasingly warmer
- It is likely that the spring and summer temperature changes (and therefor the averageseasonal air temperatures in the eastern part of the country) will be higher compared tothe rest of the country
- There will be a continual decrease in precipitation. The greatest changes, in the warmpart of the year, will be perceptible at the seasonal and annual level. At the monthlylevel, a total lack of precipitation is probable in July and August, while in February therewill be a minimal increase when compared with the average values. However, thisincrease will not be noticeable at the annual level
- In the warm part of the year the projected precipitation changes in the eastern part ofthe country are more severe than in the rest of the country
- For reasons summarized in the sections above on temperature and precipitationfindings, the results generated for Central Point A, which is representative of almostthree quarters of the country, can be used with a fair amount of certainty for the wholeterritory.

In accordance with the methodology of the study, involving averaging the results of six basicscenarios, the presented results should be taken only as guidance. The significance and influenceof the absolute values for the temperature and precipitation changes, as well as the differencesbetween these changes, will depend on the macro and micro locations of the regions taken intoconsideration.

Future climate science research results for the beneficiary country for several variables and timeperiods are provided by the World Banks Climate Change Knowledge Portal (CCKP). The portalconsists of a Google

map interface and information on historical climatology, climate changeprojections -from the IPCC Fourth Assessment Report ensemble of Global Circulation Models(GCMs) - and climate related information.
The following table shows projected changes calculated from a 40 year historical control periodcovering the years 1960-1999 for four variables for time periods 2020-2039 and 2040-2059according to two SRES emissions scenarios families, A2 and B1 where:

A2: The A2 scenario describes a very heterogeneous world. The underlying theme is self-relianceand preservation of local identities. Fertility patterns across regions converge very slowly, whichresults in continuously increasing population. Economic development is primarily oriented andper capita economic growth and technological change more fragmented and slower than inother scenarios.

B1: The B1 family describes a convergent world with the same global population, which peaks in the mid-century and declines thereafter, as in A1, but with rapid change in economic structures toward a service and technological change more fragmented and slower than in other scenarios.

<table>
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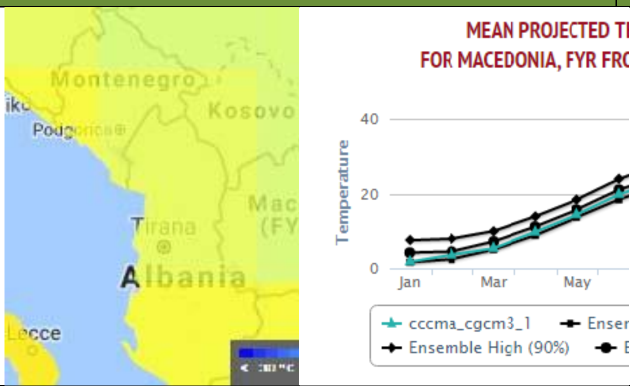
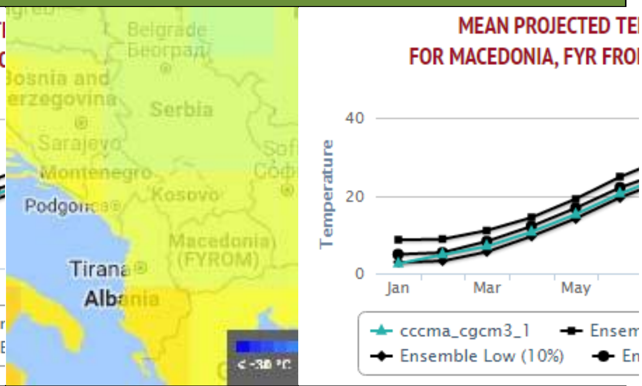
<tr><td>Temperature</td><td>
</td><td>
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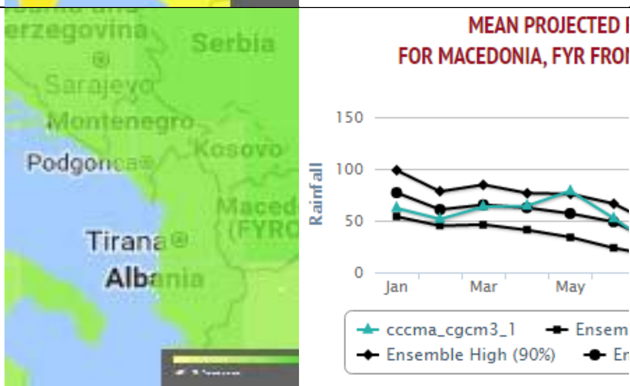
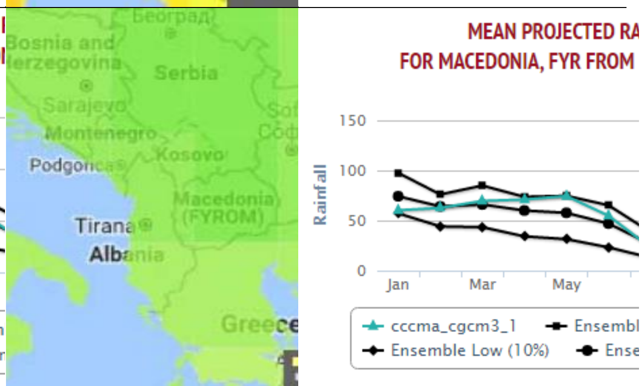
<tr><td>Rainfall</td><td>
</td><td>
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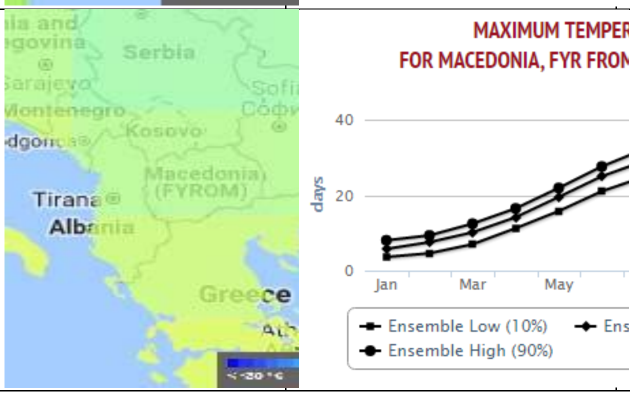
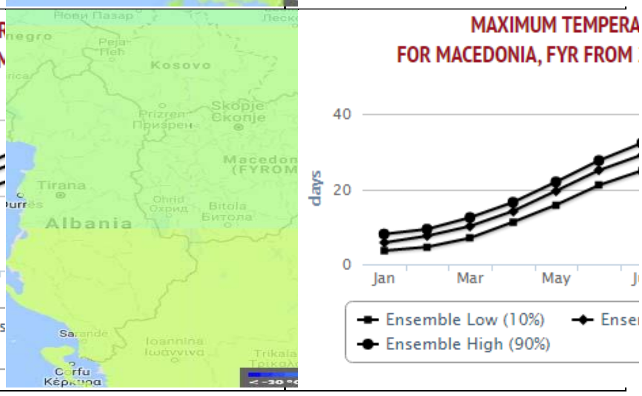
<tr><td>Maximum temperature</td><td>
</td><td>
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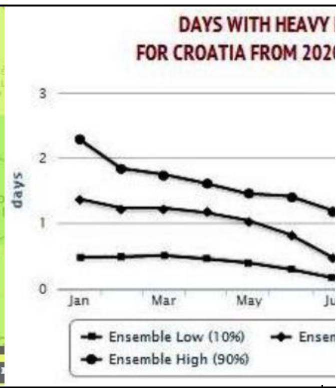
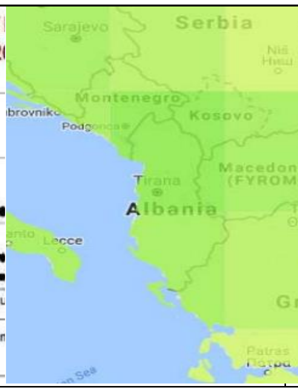
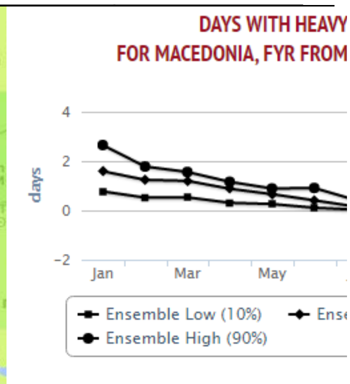
Heavy Rain	 	 

DAYS WITH HEAVY
FOR CROATIA FROM 202
days
Jan
Mar
May
Ensemble Low (10%)
Ensemble High (90%)

DAYS WITH HEAVY
FOR MACEDONIA, FYR FROM
days
Jan
Mar
May
Ensemble Low (10%)
Ensemble High (90%)

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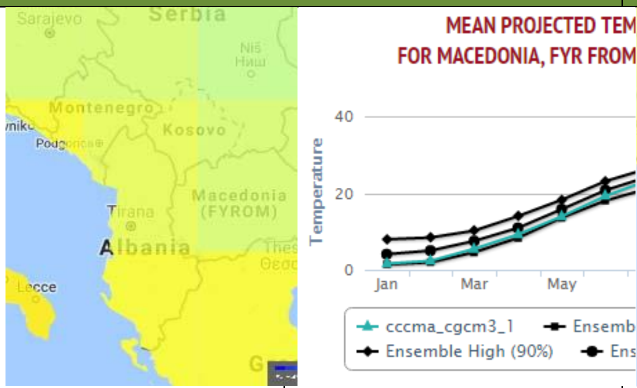
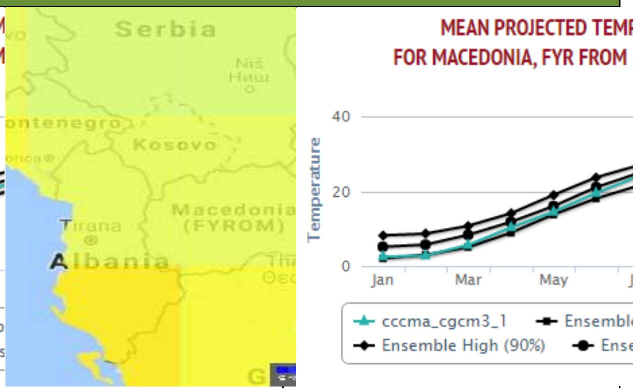
<tr><td>Temperature</td><td>
</td><td>
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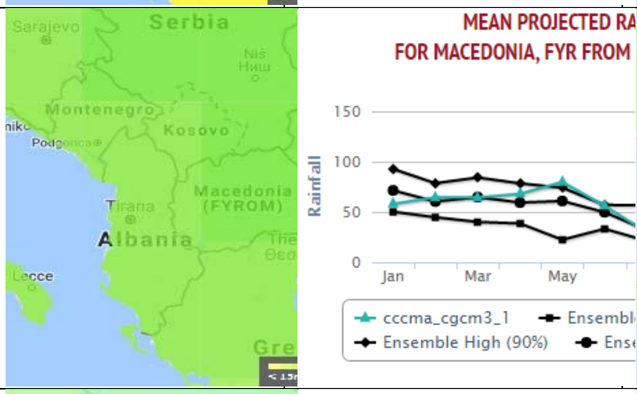
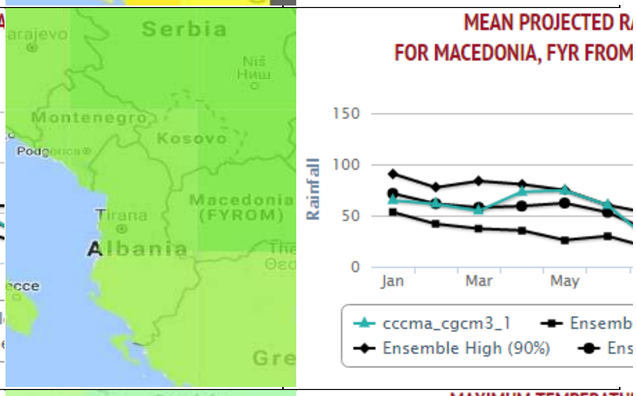
<tr><td>Rainfall</td><td>
</td><td>
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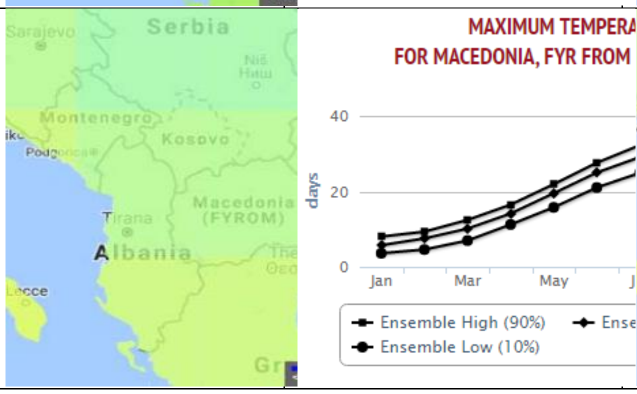
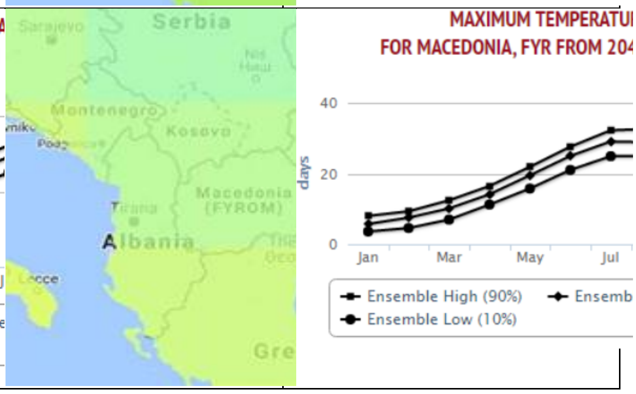
<tr><td>Maximum temperature</td><td>
</td><td>
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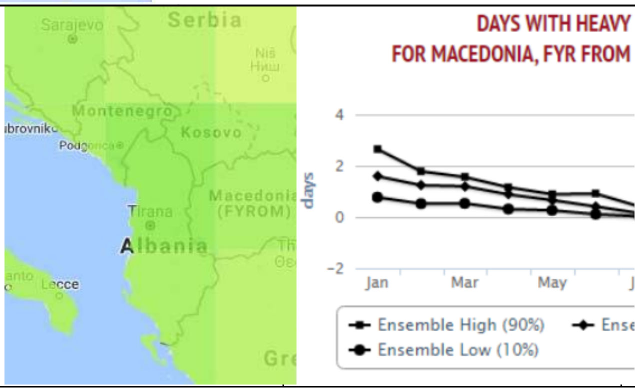
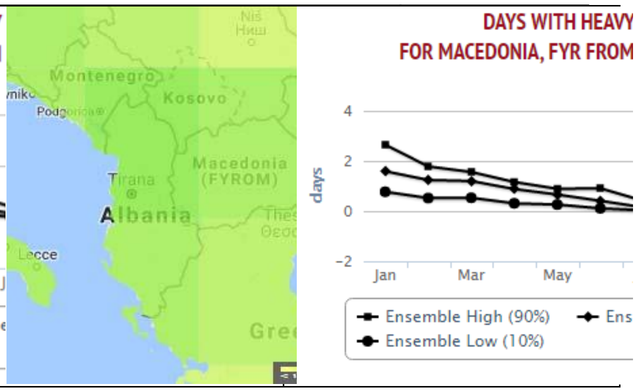
Heavy Rain	 Sarajevo Serbia Montenegro Kosovo Podgorica Macedonia (FYROM) Tirana Albania Lecce DAYS WITH HEAVY FOR MACEDONIA, FYR FROM days Jan Mar May Ensemble High (90%) Ensemble Low (10%)	 Montenegro Kosovo Podgorica Macedonia (FYROM) Tirana Albania Lecce DAYS WITH HEAVY FOR MACEDONIA, FYR FROM days Jan Mar May Ensemble High (90%) Ensemble Low (10%)

8.6.4 Policy framework, priorities and measures for climate change, mitigation andadaptation to climate change

The Republic of Macedonia is a party to the United Nations Framework Convention on ClimateChange (UNFCCC) as a non-Annex I country and party to the Kyoto Protocol without a quantifiedemissions limits and reduction commitment (QELRC). However, the country has acceded to theCopenhagen Accord, and it submitted a list of mitigation actions (without quantifying theassociated emission reductions) based on these actions.

The Ministry of Environment and Physical Planning (MOEPP) is the key governmental bodyresponsible for development of climate change policies. MOEPP has been designated as theNational Focal Point to the UNFCCC and as Designated National Authority (DNA) for KyotoProtocol implementation and is therefore the key governmental body responsible forcoordinating implementation of the provisions of the Convention and the Protocol. Otherministries that have responsibilities related to climate change are: Ministry of Agriculture,Forestry and Water Economy, Ministry of Economy, Ministry of Transport and Communication,and Ministry of Finance. Most of these ministries have appointed Climate Change Focal Points,who are responsible for mainstreaming climate change into respective policies, strategies andprogrammes. In addition, the Ministry of Health established a National Committee for ClimateChange and Health in 2009 to serve as the responsible body for surveillance activities anddecision-making in that area.

Key ministries in charge of individual policies affecting mitigation are the Ministry ofEnvironment and Physical Planning, the Ministry of Economy which implements many of thepolicies, activities and projects that directly and indirectly impact climate change mitigation inthe energy sector, the Ministry of Agriculture, Forestry and Water Economy who is in charge ofthe policies and their implementation for the agriculture and forestry sectors vis-à-vis climatechange mitigation and adaptation and the Ministry of Transport and Communications.Additionally, the National Climate Change Committee has an information collection andcoordinating role for climate change policies.

In January 2000, the Climate Change Project Office was set up within MOEPP. In addition, aNational Climate Change Committee (NCCC) was established by the Government consisting ofrepresentatives of all relevant stakeholders: government bodies, academia, private sector andcivil society. The NCCC is a participatory platform aimed at providing high-level support andguidance for overall climate change policies in the country. Moreover, a National Council forSustainable Development has also been established to advise on economic affairs.At the legislative level, climate change issues are incorporated into the Law on Environment,including details on the preparation of GHG emissions inventories as well as an action plan onmeasures and activities to abate the increase of GHG emissions and to mitigate the adverseimpacts of climate change. The Law on Environment stipulates that a National Plan for climatechange is to be adopted for the purpose of stabilizing GHG concentrations at a level that wouldprevent any dangerous anthropogenic impact on the climate system within a timeframesufficient to allow ecosystems to naturally adapt to climate change, in accordance with theprinciple of international cooperation and the goals of the national social and economicdevelopment. In July 2013, changes in the Law on Environment were adopted, and a new article(188) has been added regarding the national system of GHG emissions inventories.

This articleforesees that a national system of inventories of GHG emissions will be established and that thissystem will provide a database of relevant information for the preparation of GHG inventories aswell as monitoring of the implementation of agreements regarding climate change. This systemincorporates collection, processing, assessment, verification and quality assurance andmanagement of uncertainty, as well as storage, use, distribution and presentation of data andinformation derived from entities holding data for anthropogenic emissions by sources and sinksof greenhouse gases in the atmosphere.

Recognizing the important steps forward in the institutionalization of climate change issues andthe mainstreaming of climate change in the national and sectorial development policies, thedevelopment of three National Communications to the UNFCCC, supported by GEF and UNDP,has contributed to strengthening these integration processes as well as to informing theinternational community on the actions taken by the country to address climate change issues.

The First, Second and Third National Communications on Climate Change were published in2003, 2008 and 2014, respectively.According to the progress report for the beneficiary country – European Commission 2014, thecountry needs to develop a comprehensive policy and strategy on climate change, in accordancewith the expected EU 2030 policy framework for climate and energy. The third nationalcommunication on climate change was submitted to the United Nations Framework Conventionon Climate Change. The country regularly associated itself with EU positions in the internationalcontext, but has not yet put forward a mitigation commitment for 2020, as required by theCopenhagen Accord. The country needs to put forward by the first quarter of 2015 its intendednationally determined contribution to the 2015 Climate Agreement, consistent with those of theEU and its Member States.

Progress was made in developing the national adaptation plan: the indicators for vulnerability toclimate change were designed for eight sectors, ten local authorities drafted their socioeconomicassessments of the vulnerability of the population and an early warning system for floods wasset up. The Law on the Environment was amended in order to provide for the data collection andmanagement system used for the preparation of national inventories of greenhouse gasemissions. Aligning national legislation with the Monitoring Mechanism Regulation should be apriority. Measures to raise awareness and promote cooperation between stakeholders wereintroduced, but need to be further strengthened.

The country participated regularly in the Environment and Climate Regional Accession Networkproject. The Interinstitutional Climate Change Working Group needs to be strengthenedconsiderably in order for it to be able to address the need for more effective action on climateissues in a sustainable manner, not only on a project-by-project basis.Negligible efforts were made to strengthen the administrative capacity for implementation andenforcement of legislation, which thus continues to be largely insufficient, both at national andlocal level. Coordination between the relevant bodies remains ineffective. Stakeholders are stillnot sufficiently involved in decision-making. Enforcement of legislation is not yet efficient. Theenvironmental monitoring and information system is inadequate. Investment in the sectorremains low relative to current needs. Environmental protection and climate changerequirements are still not sufficiently integrated into policymaking and policy implementation inother areas.Although has achieved some progress towards harmonisation to the EU acquis there is still aconsiderable amount of implementing legislation that needs to be prepared.
For a successfulimplementation of the EU acquis there is a need to strengthen human and institutional capacity,especially within the area of environmental impact assessments, monitoring, integratedpollution

control and climate change. There is also a need to strengthen environmental capacitywithin local authorities.

National and regional development priorities and objectives

At the national level, the Republic of Macedonia focuses on several types of objectives in theareas of environment and climate: strategic, legislative, and institutional/organizational. A crosscuttingpriority is accession to the EU, which is at the core of the development goals ofMacedonia and a main driving force behind its objectives. The EU integration agenda hasgenerated momentum for political, economic and social reforms and contributed to buildingconsensus on important policy issues across sectors. While EU accession poses great challengesin terms of human capacity at the national and local level and identifying financial means forinvestments in key sectors, it also provides opportunities for the creation of more integrated,cross-cutting policies and better utilization of available resources.Climate change is receiving more and more attention in national policy, especially since thefinalization of the TNC. Recommendations from the TNC have been included in other strategicdocuments, studies, and sectoral policies that have been revised/developed, such as:

- The Action plan for the National Strategy for Sustainable Development
- Strategy for Energy Development
- Law on Biofuels
- National Strategy on Health and Environment (currently as a draft version)
- National Strategy for Agriculture and Rural Development for 2014-2020
- Study for Adaptation of Agriculture sector to Climate Change
- Study for Adaptation of Animal Production to Climate Change

Additionally, eight municipalities have developed climate change strategies (a USAID fundedproject) and the City of Skopje (with UNDP support) will start development of comprehensiveclimate change strategy in 2015.

At the strategic level, environmental policy (as a component of sustainable development policyand in and of itself) is covered by the National Strategy for Sustainable Development (in whichthe energy sector and climate change are identified as the main contributors towards nationalsustainable development, adopted in 2010). An action plan for implementation of the Strategy isbeing developed (with support from UNDP and USAID), and it should be finalized in February2015. It will include short-term measures that should be implemented or initiated in the period2015-2018. The Second National Environmental Action Plan is also a key environmental policy.In the past decade, a number of relevant laws, regulations and strategies that incorporateclimate change considerations have been adopted, such as:

- The Strategy for Energy Development in the Republic of Macedonia for the Period 2008-2020with a Vision to 2030 (2010) (currently being revised);
- Renewable Energy Sources Strategy of Macedonia till 2020 (2010);
- The National Strategy for Energy Efficiency in the Republic of Macedonia till 2020 (2010);
- National Environmental Investments Strategy (2009);
- National Environmental Approximation Strategy (2008);
- National Health Strategy for Adaptation in Health Sector (2010);
- A National CDM Strategy, 2008-2012 (2007);
- The National Agriculture and Rural Development Strategy 2007-2013; and
- The National Strategy for Climate Change Adaptation in Agriculture (underdevelopment).

2020 following the EU climate change policy track, e.g. reducing the energy intensity of theeconomy by 30% relative to 2006 or increasing the share of renewables (including hydropowerand wood heat) to more than 20% of total final energy. The contribution of renewable energysources (excluding biomass) to total primary energy is expected to grow by 119% over the period2011 – 2050, primarily due to expected additional wind capacity. However, half of the country'selectricity is still projected to come from lignite-fired plants, both in 2020 and in 2030, and theoverall total electricity demand is projected to grow by around 52% by 2030.The Government has also adopted eight Laws on Ratification of five Protocols under the UnitedNations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary AirPollution and they are in parliamentary procedure at the moment (National Programme forAdoption of the ***Acquis Communautaire***, 2012). In previous years, work was aimed at increasingthe reliability of data in order to enable a gradual transition to a more sophisticated greenhousegas inventory with a higher tier of analysis. The differences in terms of data collection have beenanalysed, and a proposal for a legal solution has been submitted.As far as the international policy, The Republic of Macedonia has been a non-Annex I countryparty to the United Nations Framework Convention on Climate Change (UNFCCC) since 1997 anda signatory to the Kyoto Protocol since 2004. It acceded to the Copenhagen Accord in 2009 andhas agreed to take non-binding Nationally Appropriate Mitigation Actions (NAMAs) in thecontext of sustainable development, supported and enabled by technology, financing andcapacity-building.

As previously stated, accession to the European Union is a priority for Macedonia. It was the firstcountry in the region to sign a Stabilization and Association Agreement (SAA) with the EU in April2001, and in December 2005 the Presidency of the European Council granted Macedoniacandidate status for the EU. Legislative and regulatory activities related to the accession processinclude the Ohrid Framework Agreement, the Law on Local Self-Government, the Action Plan onAccession Partnership, and the National Programme for Adoption of the ***acquis communautaire***in the environment sector. As a member of the EU, Macedonia would be obligated to participatein the EU Emissions Trading System (EU ETS).

The National GHG Inventory

The Republic of Macedonia has conducted a national inventory of anthropogenic emissions bysources and removal by sinks of greenhouse gases (GHGs) emitted to or removed from theatmosphere over a period of time. The inventory includes a database of six direct gases; CO2,CH4, N2O, PFCs, HFCs and SF6, and four indirect gases; CO, NOx, NMVOC and SO2. The purposeof the inventory is to identify the major sources and removals/sinks of greenhouse gases withgreater confidence and thus enable more informed policy decisions with respect to appropriateresponse measures. Reliable GHG inventories are essential both at national and internationallevel for assessing the community's efforts to address climate change and progress towardsmeeting the ultimate objective of the UNFCCC, for evaluating various mitigation options andcalculating long-term emission projections.The inventory is based upon updated work from Macedonia's Third National Communication onClimate Change (TNC). The GHG inventory under the TNC considered the time frame 2003–2009and was prepared in accordance with the 1996 Revised IPCC Guidelines for National GreenhouseGas Inventories and the 2000 IPCC Good Practice Guidance.

The inventory has been updated toconsider the period 2010 – 2012 and has been developed using the newest IPCC 2006 InventorySoftware. The activity data for the year 2012 is taken from the preliminary published nationalstatistical data, since the definitive national statistical data were not published while the FBURGHG inventory was developed. Additionally, the entire previous series of data from 1990 to ~~2009were revised according to the requirements of the 2006 software, thus adding value to thequal~~ity of the national greenhouse gas inventory and enabling comparable series of data for thewhole inventory period (i.e. 1990-2012).

As part of this inventory, Country Specific Emission Factors for key source categories thatcontribute more than 95% to the total GHG emissions of the inventory have been updated. Mostof the activity data were available from the State Statistical Office (MAKSTAT), Energy Balances,National Reports from the Ministry of Agriculture, Forestry and Water Economy (MAFWE), theMinistry of Environment and Physical Planning (MOEPP) and other relevant institutions. Somedata were obtained from industries and from the FAO database. For emission factors, 90% ofvalues are country-specific (CS) and IPCC default values were used taking into account expertjudgment.

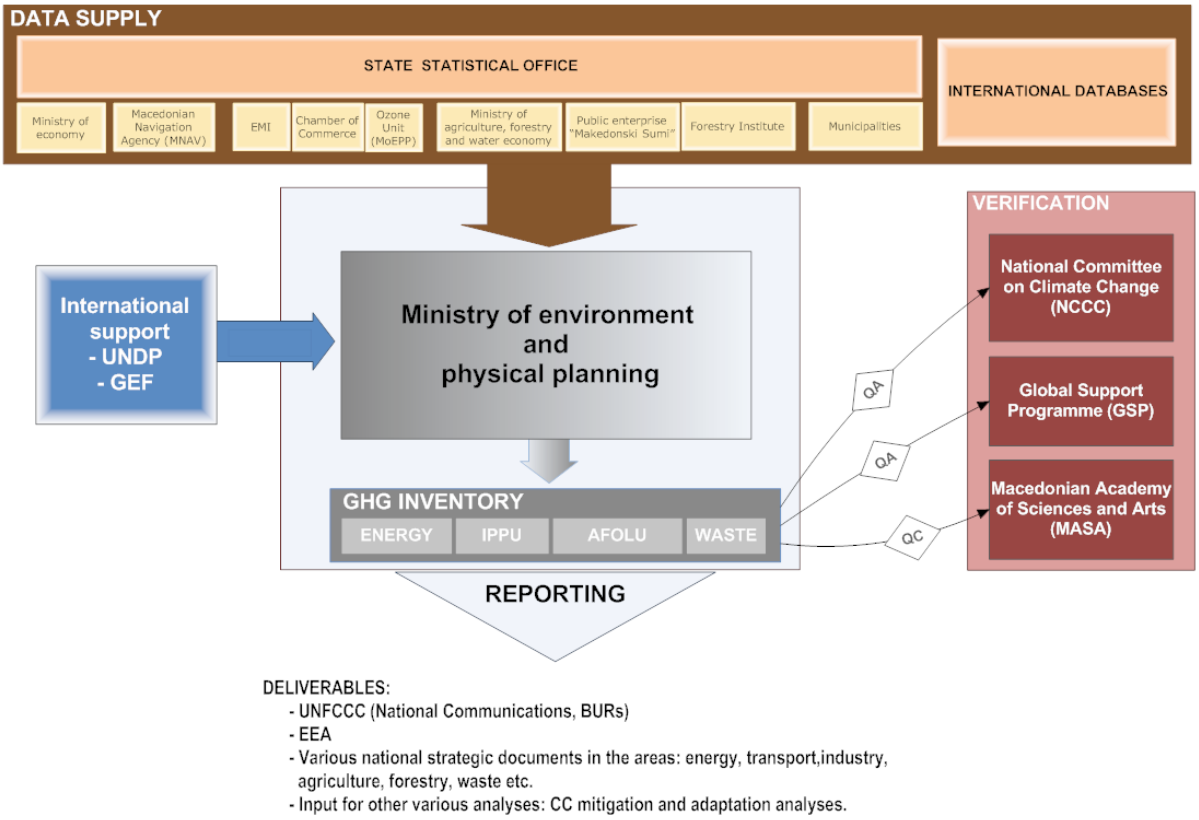


Figure 8-7: MRV Scheme for GHG inventory preparation

An uncertainty analysis consisting of running the Monte Carlo algorithm on the inventory data was also performed for each CO2-emitting category for the whole period 1990 – 2012.

The analysis was conducted by using the built-in functionality of the 2006 IPCC software. The overall results showed that the uncertainty in the GHG inventory is 3.13% and the trend uncertainty is 5.41%. GHG inventory preparation was coordinated by the Ministry of Environment and Physical Planning and managed by a GHG inventory team with support from a national technical advisor and the National Communication Support Programme (NCSP). NCSP provided review from an experienced consultant that highlighted improvements in preparing an extensive, detailed and complete series of emissions data.

The institutional structure shown in the following figure ensures sustainability in preparing GHG inventories. Additionally, training materials were prepared for each sector, including a step-bystep process for completing inventory tables, explanations of good practices and sources of data and emission factors.

The national structure for the development of the National GHG inventory is described:

- **The Ministry of Environment and Physical Planning**, responsible for supervising thenational inventory process and reporting the emissions to UNFCCC
- **The Project Management Unit**, responsible for managing and coordinating the FirstBiennial Update Report on climate change
- **The GHG Inventory Team**, composed of experts responsible for preparing the GHGinventory in four different sectors (Energy, IPPU, AFOLU and Waste)
- **A National Technical Advisor**, responsible for training and transfer of knowledge to theGHG inventory team and for supervision and verification of the GHG inventory
- **The Global Support Programme (GSP)**, responsible for supporting and revising the GHGinventory

According to the "Preparation of the GHG Inventory for the Third National Communication to theUNFCCC – National Inventory Summary Report", Final version 2013, for the beneficiary country,data for the contribution of the waste sector to the GHG emissions are giving below.The revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories provide an outline oftwo methods for estimating emissions of CH_4 from solid waste disposal sites: the default method(Tier 1) and the first order Decay (FOD) method (Tier 2). The main difference between these twomethods is that the FOD method produces a time – dependent emission profile that reflects thetrue pattern of the degradation process over time. Good Practice Guidance and UncertaintyManagement in National Greenhouse Gas Inventories (GPG 2000, IPCC, 2000) describes twomethods for estimating CH_4 emissions from SWDS: the mass balance method (Tier 1) and theFirst Order Decay (FOD) method (Tier 2). In the IPCC Guidelines, the use of the mass balance

method which produces more accurate estimates of annual emissions. Instead of the massbalance method, the Tier 2 and FOD methodology is suggested. The following sources are usedfor GHG emissions for the waste sector: CH_4 emissions from solid waste disposal sites, CH_4emissions from solid waste disposal sites, CH_4 emissions from residential/commercialwastewater and sludge, CO_2 emissions from waste incineration and N_2O emission from humansewage and domestic/industrial wastewaters.

Most of the GHG emissions in this sector come from solid waste disposal sites (methaneemissions), while emissions from incineration and wastewater handling have an equalimportance in total emissions. Emissions from this sector slowly increased during the inventoryperiod, since the increased population produces higher emissions from the disposal andincineration of municipal solid waste.

Policies and measures for reduction of the emissions and mitigation of the climate change are inthe function of fulfilling the beneficiary country's international obligations under the KyotoProtocol Convention and the EU acquis and the starting point for long-term development of theeconomy with low emissions of greenhouse gases.

As mentioned above, the beneficiary country acceded to the UNFCCC in 1998 and to the KyotoProtocol in 2004. The MOEPP is the focal point for the UNFCCC, and also the Designated NationalAuthority for the CDM. The Climate Change Project Office was set up in 2000 and sits as a unitwithin the MOEPP, driving work on climate change within the ministry. The National ClimateChange Committee (NCCC) is separate from the MOEPP and is composed of representatives ofgovernment (including inter-alia, ministries of the Environment, Finance, Transport, Economy,Education and Science, Health and Agriculture, Forestry and Water), NGOs, the private sectorand research organisations. The function of the NCCC is to oversee national policies on climatechange and to ensure that these policies are consistent with national development strategiesand priorities. Implementation of environmental policy occurs through a wide range of publicand private sector entities, and the MOEPP is only the coordinator of environmental policy.

Macedonia has started to integrate climate change into national strategic planning documentsand laws. Article 4 of the Law on the Environment explicitly mentions 'Restraining greenhousegas emissions in the atmosphere' and encouraging the use of clean technologies and renewableenergy. In the Law on the Environment it is stipulated that Macedonia should adopt a NationalPlan on Climate Change, but this has not yet been developed. The Second NationalEnvironmental Action Plan (NEAP) and the National Strategy for Sustainable Development(NSSD) both documents include climate change, with Energy and Climate being identified as keyelements in achieving the goals of the NSSD The focus in the NSSD are to develop a less carbonintensive energy sector (through both switching supply and increasing efficiency) and to engagestrongly with the CDM. Adaptation is recognized in the strategy but is secondary to mitigation.

Measures in the strategy to conserve and manage natural resources will also improve theadaptive capacity of ecosystems.The focus of the government has been on mitigation rather than adaptation to climate change,however there is an Inter-Sectoral Adaptation Action Plan which includes integrating adaptationinto the management strategies for different sectors, establishing early warning and monitoringsystems and building the capacity of different actors through training and the provision ofadditional funding. Decentralization is a key pillar of the national strategies of Macedonia, and assuch it is local government and other local actors who will be tasked with the implementation ofmany of these plans. The government recognizes the need to rapidly build the capacity in theseactors if national environmental strategies are to be successfully implemented.EU membership can be considered as the overall strategic objective for current developmentpolicies in Macedonia, and strategy documents such as the 2nd National Environmental ActionPlan are aimed at the requirements in the EU acquis, and harmonisation of environmentalpolicies. The second National Communication has strengthened national capacity on preparinggreenhouse gas inventories; however several institutional and legislative measures need to beadopted to further strengthen and embed this procedure. This inventory will serve as thebackground for the establishment of a GHG registry, which is a country requirement for EUaccession. There will need to be some amendments to the existing Law on the Environment andLaw on Energy in order to pave the way for a Law on GHG allowance trading so that the EmissionAllowance Trading Directive can enter into legislation.

A pilot emissions trading scheme will beadopted for 2 years in order to prepare local actors to participate in the EU emissions tradingscheme. It is unclear what effect Macedonia becoming a member of the EU would have on theEU's targets for a 20% reduction in emissions by 2020, to be achieved by country specificreductions, and whether a target would be imposed on the country. If new countries areincluded in this target then there will be negotiations to set a target that takes into accountnational circumstances. It is extremely unlikely the beneficiary country would be obliged to makethe full 20% reduction, but may be required to ensure that its emissions do not grow over theperiod, for example. In the area of energy and climate in the Republic of Macedonia appears tobe progressing well towards the requirements for EU integration.

Waste sector

The Waste sector is one of the key GHG emission sources in the beneficiary country. Wastemanagement in the country was recently recognized as an issue of concern and a concentratedeffort was put forward in order to mitigate its adverse impacts on the environment and society.The First and Second National Environmental Action Plan, as well as The Law on WasteManagement give the general policy directions on waste management and constitute regulationacts that provide general rules applying to main issues on non-hazardous and hazardous wasteand on special waste streams. The National Waste Management Strategy is another programmedocument that defines the fundamental directions in waste management.
Most of the GHG emissions in the Waste sector come from Solid Waste Disposal Sites (SWDS),while emissions from incineration and wastewater handling have an equal importance in totalemissions.

Waste sector emissions mainly consisted of CH_4 (methane) emissions (94%). Typically, CH_4emissions from SWDS were the largest source of greenhouse gas emissions in the Waste Sector.CH4 emissions from wastewater treatment and discharge were also significant. N_2O emissionswere the second biggest source of waste sector GHG emissions. Incineration and open burning ofwaste containing fossil carbon, e.g., plastics, were the most important sources of CO_2 emissionsin the Waste Sector.In almost all cases of waste management, there is an upward trend of emissions due topopulation growth and an improving economy. Higher personal incomes have resulted in ahigher waste generation per capita:

- **Solid waste disposal**: Solid waste disposal sites (SWDS) produce methane (CH_4), biogenic carbondioxide (CO_2), non-methane volatile organic compounds (NMVOCs) as well as smaller amounts ofnitrous oxide (N_2O), nitrogen oxides (NOx) and carbon monoxide (CO). For the period 1990 –2012 SWDS were responsible for an average of 89.9% of the overall GHG emissions of the wastesector. Almost 100% of the SWD emissions consisted of CH_4 emissions.
- **Incineration and open burning of waste:** Similar to other types of combustion, incineration andopen burning of waste contribute to GHG emissions. Relevant gases emitted from incinerationinclude CO_2, methane (CH_4) and nitrous oxide (N_2O). Normally, emissions of CO_2 from wasteincineration are more significant than CH4 and N2O emissions. For the period 1990 – 2012 theopen burning of waste was responsible for an average of 1.4% of the overall GHG emissions ofthe waste sector. Approximately 36% of the emissions of this sector consisted of CO2 emissions,while CH_4 emissions represented 63.5% of the emissions. The share of N_2O emissions wasnegligible – 0.02%.
- **Waste water treatment and discharge**: The emissions from the wastewater treatment anddischarge originate from Domestic Wastewater Treatment and Discharge and IndustrialWastewater Treatment and Discharge. The emissions of this subsector representedapproximately 8.7% of the total waste sector emissions during the period 1990 – 2012. The GHGemissions of this subsector were comprised of two main gases: CH_4 emissions (61.8%) and N_2Oemissions (38.2%).Similar to the other forms of waste, domestic wastewater treatment and discharge emissionshave been in line with population growth. In contrast, as described in Section 3.4 on Industrialprocesses, emissions from the Industrial wastewater treatment and discharge have had a highlyfluctuating trend; industrial waste emissions proved to be highly dependent on industrialproduction rates which were variable between 1990 and 2012. Future emissions for theWastewater Treatment and Discharge will be more detailed, since the industry will reportdirectly in the EMI software.

Waste sector emissions were estimated in accordance with the most recent IPCC 2006Guidelines and 2006 Inventory Software. As already mentioned, the Tier 2 First Order Decay(FOD) methodology was applied for estimation of the waste sector GHG emissions when a longenough time series was available (generally 50 years). If data was missing, the Tier 1 method anda MSW disposal rate of 0.79 kg per capita per day were used. For both Tier 1 and Tier 2calculations, the FOD methodology was applied by default, as imposed by IPCC 2006 guidelines.Historical data have been taken from official censuses from 1950, 1962, 1971, 1981, 1991, 2002and current population estimations from the State Statistical Office. Data for the missing yearswere obtained by extrapolation (Source First Biennial update report on Climate Change, MOEPP,2013).

Data was also taken from the GHG Inventory for the Second National Communication for 1999–2002 which consisted of the inventory of N_2O emissions from human sewage and methaneemissions from sub-sectorial sources, including solid waste disposal sites, domestic/ commercialorganic wastewater and sludge, and industrial wastewater and sludge. Activity data were takenfrom State Statistical Office publications, MOEPP reports, FAO statistics and the UN Statisticaldatabase.

According to the report “Third National Communication on climate change”, total annualquantities of waste generated in the country are 26,218,257 t of which the biggest parts (95%)are related to: extraction and processing in the mining industry (66%), agriculture waste (21%)and waste from thermal processing industry (8%). The remaining waste is industrial, constructionand municipal waste, medical waste and waste water treatment waste.All data extracted from the “Third National Communication on climate change”. The baselinescenario for the waste sector was developed and emissions are calculated using TIER2methodology and taking into account disposed waste from year 1981 onward projected until2030 based upon expected population and economic growth. The basic assumption is that therewill be no investment in new landfills but that existing sites will only have maintenance costs thatamount 3.45 euro/t on average. The following figure shows the expected trajectory of GHGemissions from the waste sector in the baseline scenario. There are five different WasteManagement Regions, according to the report, proposed for the development of the regionallandfills:

- WMR1: Skopje region
- WMR2: East, Northeast and Vardar regions
- WMR3: Southeast region
- WMR4: Pelagonija and Southwest regions
- WMR5: Polog region

Mitigation measures in the waste sector

The proposed measures for reduction of GHG emissions target two types of landfills: existing non–compliant landfills and new regional landfills. Additional mitigation measures are possible forwastewater treatment from households and industry but were not analysed for the purposes ofthe TNC.

From the wastewater treatment sector for households, the mitigation measure is generally thedevelopment of new sewage system in the settlements that are not covered with organizedcollection of sewage and upgrading of the existing sewage systems. These measures are mainlydriven by the Government policies, prioritization in municipalities and foreign funds. Since theyare not easily predicted, these measures are not analysed further.

For the wastewater treatment sector for industry, the mitigation measure is the implementationindustrial wastewater treatment plants which are already a part pf IPCC requirements and theyneed to complete their applications by the year 2019. Since these emissions are only 1.58% oftotal waste emissions and depend on private investments of industries, they are not analysedfurther in this document.

For municipal solid waste management, the National Waste Management Strategy (2008 2020)prescribes the establishment of the new regional municipal waste management systems inaccordance with EU requirements on landfilling and the implementation of an integratedapproach. In this plan, new regional landfills would be opened in all Waste ManagementRegions. The overall aim of the Waste Management Strategy is as much as possible to reducewaste sent to the landfills. In practice this means collection, transportation and disposal ofwaste, waste treatment and eventual use of Refuse Derived Fuel as fuel in cement facilities as afinal stage of the waste management cycle. The closing of existing landfills and development ofnew regional landfills are connected because the closure and remediation measures for theexisting non-compliant landfills cannot be implemented if there is no construction of the new regional landfills. Therefore there are five basic measures for GHG mitigation in the waste sector:

- **Measure 1: Closing and covering the existing non – compliant landfills followed by gas*extraction and flaring*.** The current practice of the municipal landfills is only to unload the wastewithout compaction and covering activities. Based on the special study of the National WasteManagement Plan 1 – (2006 – 2012) there are 55 landfills which are not in accordance with theEU standards. For these existing landfills the most feasible option suggested by waste expertsworldwide and prescribed in the NWMP1 is to cover the whole disposal area and introduce gasextraction and flaring, converting methane emissions to CO_2 which has significantly lower globalwarming potential. Burning one tonne of CH4 results in an 87% reduction of CO_2-eq which is asignificant GHG reduction. The RWMP and Integrated WMS which will applied in Skopjeregion includes the closure and rehabilitation of non-compliant landfill. This will contribute tothe reduction of GHG emission of uncontrolled disposal waste.
- ***Measure 2: Mechanical and biological treatment (MBT).*** This measure involves the sorting of waste for removal of metals, plastics and glass. It is necessary step for any other treatment (composting, anaerobic treatment, or RDF development). The future WMC will include Mechanical Biological treatment and Material Recovery Facility plant with sorting of recyclables and composting of organics. WMC also includes Drisla landfill which is constructed according national and EU regulations.
- ***Measure 3: Aerobic treatment (composting)*.** The process of composting simply requires making a heap of wetted organic matter and breaking down the materials into humus over a period of weeks or months usually including closely monitored inputs of water, air, and materials. Aerobic bacteria manage the chemical process by converting the inputs into heat, carbon dioxide and ammonium. There is a reduction of GHGs by reducing methane emissions and instead resulting in CO2 emissions.
- ***Measure 4: The production of SRF (RDF).*** The production of SRF involves converting combustible waste materials to an engineered fuel.

8.6.5 Integrating climate resilience into the conventional asset lifecycle

Even if the 2°C limit is kept, substantial impacts on society, human health and ecosystems areprojected to occur. Climate change can increase existing vulnerabilities and deepensocioeconomic imbalances in Europe. Impacts of climate change, such as an increased frequencyof extreme weather events or changing water and air temperatures may impact on the stabilityand the functioning of infrastructure. Adaptation to and mitigation of climate change aretherefore both needed.

The term Adaptation to Climate Change refers to adjustments in natural and human systems inresponse to actual or expected climate change impacts, which moderate harm or exploitbeneficial opportunities (IPCC, 2007). Adaptation can thus be justified as a way of reducing thenegative impacts of climate change and can take a variety of forms. It can involve a set ofproactive and planned measures consciously undertaken to meet anticipated climate changes.

"Adaptation to climate change is an ongoing and reiterative process that includes informationdevelopment, awareness raising, planning, design, implementation and monitoring" (StockholmEnvironment Institute, 2008, p. 38).

Adaptation is necessary to avoid or reduce the negative impacts and to explore any potentialbenefits of climate change. The goals of adaptation are to alleviate current impacts, reducesensitivity and exposure to climate-related hazards, and increase resistance to stress factors(Warren & Egginton, 2008).Although infrastructure is generally constructed in a manner that is resilient to the weatherconditions of the past, climate change is already happening and its effects will continue to havefar-reaching consequences for human and natural systems. Adaptation action is needed toprotect people, buildings, infrastructure, businesses and ecosystems. Due to the varying severityand nature of climate impacts between regions in Europe most adaptation initiatives will betaken at national, regional or local level.

The European commission (Directorate – General Climate Action) has issued a Guideline withprimary objective to help developers of physical assets and infrastructure incorporate resilienceto current climate variability and future climate change within their projects. The Non-paperGuidelines for Project Managers: Making vulnerable investments climate resilient forms part ofthe overall EU effort to mainstream climate change adaptation, following on from the WhitePaper on Adapting to Climate Change published by the Commission in 2009. The Commissionstrongly encourages the use of the Guidelines, both in EU-funded projects and more widely, asthey are designed to provide support to developers of physical assets and infrastructure.The Guideline proposes seven modules that make up the climate resilience toolkit and aresummarized in the following table.

The seven modules that make up the climate resilience toolkit are summarized in the followingtable. The modules provide common methodologies which can be applied at several stagesduring the project development. Modules 1 to 4 have both 'high level' and 'detailed' versions.The high level versions are rapid screening exercises undertaken early in the projectdevelopment cycle, and the detailed versions are applied later in the cycle, if necessary, whenmore information is available about the project as a basis for analysis.

Table 8-13: Seven modules in the climate resilience toolkit

Module No.	**Module name**	**High level and detailed versions?**
1	Sensitivity analysis (SA)	***Yes***
2	Evaluation of exposure (EE	***Yes***
3	Vulnerability analysis (incorporating the outputs of modules 1 and 2) (VA)	***Yes***
4	Risk assessment (RA)	***Yes***
5	Identification of adaptation options (IAO)	***No***
6	Appraisal of adaptation options (AAO)	***No***
7	Integration of adaptation action plan into the project (IAAP)	***No***

Source: Non-paper Guidelines for Project Managers-Making vulnerable investments climate resilience

The present study (Feasibility Study) is a part of Plan and Design stage, and the main objectivesof climate resilience analysis are the consideration and articulation of the climate vulnerabilitiesand risks associated with the development covering all areas of feasibility: project inputs(availability and quality), project location and site, financial, economic, operations andmanagement, legal, environmental and social. The relevant modules (according the above table)that must be followed are

- Modules 1-3, Sensitivity analysis, evaluation of exposure, vulnerability analysis.
- Module 4, Risk assessment
- Module 5, Identification of adaption measures
- Module 6, Appraisal of adaptation options

8.6.5.1 Module 1: Identification of the climate sensitivities of the project

Module 1:
The sensitivity of the project should be determined in relation to a range of climate variables andsecondary effects/climate related hazards. The following table provides a list of factors toconsider.

Table 8-14: Key climate variables and climate-related hazards

Primary climate drivers	Secondary effects/climate
1. Annual/seasonal/monthly average (air) temperature (1) 2. Extreme (air) temperature (frequency and magnitude) (2) 3. Annual/seasonal/monthly average rainfall (3) 4. Extreme rainfall (frequency and magnitude) (4) 5. Average wind speed (5) 6. Maximum wind speed (6) 7. Humidity (7) 8. Solar radiation (8)	1. Sea level rise (9) 2. Sea/water temperatures (10) 3. Water availability (11) 4. Storm (tracks and intensity) including storm surge (12) 5. Flood (13) 6. Ocean pH (14) 7. Dust storms (15) 8. Coastal erosion (16) 9. Soil erosion (17) 10. Soil salinity (18) 11. Wild fire (19) 12. Air quality (20) 13. Ground instability/landslides/avalanche (21) 14. Urban heat island effect (22) 15. Growing season length (23)

The sensitivity of the project options to key climate variables and hazards should besystematically assessed through the lens of four key themes encompassing the main componentsof a value chain as follows:

- On-site assets and processes
- Inputs (water, energy, others)
- Outputs (products, markets, customer demand)
- Transport links

The focus is on determining the sensitivity of project options to climate variables in relation toeach of these four themes.

The following table presents the sensitivity matrix for Skopje region TSs.

Table 8-15: Sensitivity matrix for TSs

Project type	Sensitivity theme	Incremental air temperature increase	Extreme temperature increase	Incremental rainfall change	Extreme rainfall change	Average wind speed	Maximum wind speed	Humidity	Solar radiation	Relative sea level rise	Seawater temperature	Water availability	Storms	Flooding (coastal & fluvial)	Ocean pH	Dust storms	Coastal erosion	Soil erosion	Soil salinity	Wild fire	Air quality	Ground instability/ landslides	Urban heat island	Growing season
Waste Management Center	On-site assets and processes	MEDIUM	HIGH	MEDIUM	HIGH	NO	HIGH	MEDIUM	MEDIUM	NO	NO	HIGH	HIGH	HIGH	NO	MEDIUM	NO	MEDIUM	NO	HIGH	NO	HIGH	NO	NO
	Inputs (water, energy, others)	HIGH	HIGH	HIGH	HIGH	NO	HIGH	MEDIUM	MEDIUM	NO	NO	HIGH	MEDIUM	MEDIUM	NO	NO	NO	MEDIUM	MEDIUM	MEDIUM	NO	NO	NO	NO
	Outputs (products and markets)	MEDIUM	HIGH	MEDIUM	MEDIUM	NO	MEDIUM	NO	MEDIUM	NO	NO	NO	MEDIUM	MEDIUM	NO	NO	NO	NO	NO	MEDIUM	MEDIUM	NO	NO	NO
	Transport links	MEDIUM	HIGH	MEDIUM	HIGH	NO	HIGH	MEDIUM	NO	NO	NO	NO	HIGH	HIGH	NO	MEDIUM	NO	MEDIUM	MEDIUM	HIGH	NO	HIGH	NO	NO

Climate sensitivity	NO	MEDIUM	HIGH

Note:
High sensitivity: Climate variable/hazard may have significant impact on assets and processes, inputs, outputs andtransport links.
Medium sensitivity: Climate variable/hazard may have slight impact on assets and processes, inputs, outputs andtransport links.
No sensitivity: Climate variable/hazard has no effect.

8.6.5.2 Module 2: Evaluation of exposure to climate hazards

Module 2:
Once the sensitivities of the project have been identified, the next step is to evaluate exposure ofthe project and its assets to climate hazards in the location where the project will beimplemented.

Assess exposure to baseline/observed climate

Exposure data should be gathered for climate variables and related hazards to which assets havehigh or medium sensitivity from Module 1. In each case the information required will be madeup of spatial data relating to observed data.

The following table presents the exposure to baseline/observed climate of the TSs.

Table 8-16: Exposure to baseline/observed climate of the TSs

		Climate variables / climate-related hazards																							
Project type	**Sensitivity theme**	Incremental air temperature increase	Extreme temperature increase	Incremental rainfall change	Extreme rainfall change	Average wind speed	Maximum wind speed	Humidity	Solar radiation	Relative sea level rise	Seawater temperature	Water availability	Storms	Flooding (coastal & fluvial)	Ocean pH	Dust storms	Coastal erosion	Soil erosion	Soil sality	Wild fire	Air quality	Ground instability/ landslides	Urban heat island	Growing season
Exposure to baseline/observed climate																									
Waste Management Center	On-site assets and processes																								
	Inputs (water, energy, others)																								
	Outputs (products and markets)																								
	Transport links																								

Climate sensitivity	NO	MEDIUM	HIGH

Note:
High sensitivity: Climate variable/hazard may have significant impact on assets and processes, inputs, outputs andtransport links.
Medium sensitivity: Climate variable/hazard may have slight impact on assets and processes, inputs, outputs andtransport links.
No sensitivity: Climate variable/hazard has no effect.

Table 8-17:Assess exposure to future climate

Project type	**Sensitivity theme**	Incremental air temperature increase	Extreme temperature increase	Incremental rainfall change	Extreme rainfall change	Average wind speed	Maximum wind speed	Humidity	Solar radiation	Relative sea level rise	Seawater temperature	Water availability	Storms	Flooding (coastal & fluvial)	Ocean pH	Dust storms	Coastal erosion	Soil erosion	Soil salinity	Wild fire	Air quality	Ground instability/ landslides	Urban heat island	Growing season
Exposure to future climate		MEDIUM	MEDIUM	MEDIUM	HIGH	NO	MEDIUM	MEDIUM	MEDIUM	NO	NO	MEDIUM	HIGH	HIGH	NO	NO	NO	NO	NO	NO	NO	MEDIUM	NO	NO
Waste Management Center	On-site assets and processes	MEDIUM	HIGH	MEDIUM	HIGH	NO	HIGH	MEDIUM	MEDIUM	NO	NO	MEDIUM	HIGH	HIGH	NO	NO	NO	MEDIUM	NO	MEDIUM	NO	MEDIUM	NO	NO
	Inputs (water, energy, others)	HIGH	HIGH	HIGH	HIGH	NO	HIGH	MEDIUM	MEDIUM	NO	NO	MEDIUM	MEDIUM	MEDIUM	NO	NO	NO	MEDIUM	MEDIUM	NO	NO	NO	NO	NO
	Outputs (products and markets)	MEDIUM	HIGH	MEDIUM	MEDIUM	NO	MEDIUM	NO	MEDIUM	NO	NO	NO	MEDIUM	MEDIUM	NO	NO	NO	NO	NO	NO	MEDIUM	NO	NO	NO
	Transport links	MEDIUM	HIGH	MEDIUM	HIGH	NO	HIGH	NO	NO	NO	NO	NO	HIGH	HIGH	NO	NO	NO	MEDIUM	MEDIUM	MEDIUM	NO	MEDIUM	NO	NO

Climate sensitivity	NO	MEDIUM	HIGH

Note:
High sensitivity: Climate variable/hazard may have significant impact on assets and processes, inputs, outputs andtransport links.
Medium sensitivity: Climate variable/hazard may have slight impact on assets and processes, inputs, outputs and transport links.
No sensitivity: Climate variable/hazard has no effect.

8.6.5.3 Module 3: Assess vulnerability

Module 3:
Vulnerability (V) is calculated as follows:
V=SxE, where S is the degree of sensitivity that asset has and E is exposure to baseline climateconditions/secondary effects. The following table presents the vulnerability classification matrixfor each climate variable/hazard which could impact the project.

Table 8-18: Vulnerability classification matrix for each climate variable/hazard which could impact the project (baseline climate)

		Exposure		
		No	Medium	High
Sensitivity	No	2, 5, 7, 8, 9, 10, 14, 15, 16, 18, 20, 22, 23		
	Medium	11, 17, 19	1, 3, 21	4, 6
	High		12, 13	

Vulnerability level
No
Medium
High

Table 8-19: Vulnerability classification matrix for each climate variable/hazard which could impact the project (future climate)

		Exposure		
		No	Medium	High
Sensitivity	No	5, 9, 10, 14, 15, 16, 18, 20, 22, 23		
	Medium	17, 19	1, 3, 7, 8, 11, 21	
	High		2, 6	4, 12, 13

Vulnerability level
No
Medium
High

The numbers 1-23 represents the Key climate variables and climate-related hazards that presentedduring module 1 description.

8.6.5.4 Module 4: Assess risks

Module 4:
The following risk assessment matrix was used to determine the risk of each individualenvironmental aspect relevant to the TSs. The level of risk determined from the matrixidentifies the level of control measures required for that environmental aspect.

Table 8-20: Risk Assessment Matrix

Severity						
Probability		I	II	III	IV	V
	A	Low	Low	Low	Low	Moderate
	B	Low	Low	Moderate	Moderate	High
	C	Low	Moderate	Moderate	High	High
	D	Low	Moderate	High	Very High	Very High
	E	Moderate	High	Very High	Very High	Very High

Risk level	Colour
Low	
Moderate	
High	
Unacceptable	

Probability			Severity		
A	Very unlikely	0-10%	I	Insignificant	No relevanteffect on social welfare, evenwithout remedial actions
B	Unlikely	10-33%	II	Minor	Minorlossofthesocialwelfaregenerated by the project,minimallyaffectingthe projectlongruneffects. However,remedial or corrective actions needed
C	Aboutas likely as not	33-66%	III	Moderate	Social welfare loss generatedbytheproject, mostly financial damage, eveninthemedium-longrun. Remedial actions may correct the problem
D	Likely	66-90%	IV	Critical	Highsocialwelfarelossgenerated bytheproject:the occurrenceof therisk causesalossofthe primaryfunctionsof the project. Remedial actions,evenlarge in scope, are not enoughto avoid serious damage
E	Verylikely	90-100%	V	Catastrophic	Projectfailurethatmayresultinseriousoreve ntotal lossoftheproject functions.Mainproject effectsinthemedium-longterm do not

Source: Guide to cost benefit analysis of investment projects 2014-2020

8.6.5.5 Module 5 and 6: Identification of adaptation options and appraise adaptationoptions

Taking into consideration the non-paper guidelines for project Managers: Making vulnerableinvestments climate resilience and annex III 'Illustrative examples of adaptation options byproject category' the following table provides adaptation options for environmentalinfrastructures.

Table 8-21: Adaptation options for environmental infrastructures

Project category	Climate variable and climate related hazards	Geographical vulnerability	Climate change impacts	Adaptation options
Environmental infrastructure	Increased flood risk from storm surges, increased precipitation and rising ground water Decrease in precipitation and increased evaporation from highertemperatures Increased frequency and intensity of heat waves, drought and fires Extreme temperature fluctuations	Climate regions Local topography River beds Valleys Lowland Flat land and delta regions Mountains	Damages to human settlements, production facilities, infrastructure, agricultural areas and human health Soil erosion and landslides Reduced water quality	Design in accordance with range of future climate conditions Retention and diversion of water Re-alignment and/or upgrading of infrastructure Spatial planning Alert and emergency systems Environmental management

Municipal waste originates from a variety of sources, with material types that includeelectronics, plastics, metals, glass, human fecal matter, and other hazardous materials that maybe toxic, corrosive, radioactive, flammable, or infectious. Waste disposal systems are oftenlogistically complicated and costly, including an operational chain of collection, transfer, anddisposal. Capital costs of technologically advanced treatment, such as anaerobic digestion orincineration, can be prohibitively high. As cities grow and need more land, suitable collection anddisposal sites can be difficult to acquire and develop.

Adaptation Approaches

Reducing vulnerability to solid waste-related flooding in cities requires improvement in solidwaste management practices. One step is to develop regular and proactive collection of solidwaste from drains, streets, and waterways; this can be taken as a low-cost measure in advanceof an anticipated storm. Solid waste authorities can also reduce waste-related flooding risks byimproving landfill siting decisions with information about geology, groundwater tables, floodinghazards, proximity to surface water, and proximity to vulnerable populations (UNEP 2009).

Cities can also reduce vulnerability to health risks through practices that avoid or reduce highconcentration of pollutants in water after periods of floods or droughts. In collection anddisposal services, cities can increase the use of corrosive-resistant, lined and lidded storagesystems, minimize accumulation of waste and informal disposal, increase the frequency ofcollection to remove organic wastes, and minimize the number and spatial coverage of wastedisposal sites. In transfer and transport services, cities can change waste management routesaway from surface water supplies or flood plains and ensure accessibility of major routes.

More broadly, providing broader and better coverage of solid waste services throughout a city,particularly for informal settlements, would be the long-term solution. This involvesstrengthening existing waste operations through improvement of collection, disposal andtransfer routes, siting of new facilities and waste management stations, and increased efficiencyn the transfer and treatment of waste—efforts that would in any case be needed in the solidwaste sector independent of climate change. Many cities (particularly in low-income countries)face a variety of challenges in addressing solid waste, not least the financing of ongoing solidwaste operations.

In order to promote adaptation to climate change from the Waste-related Impacts, communitiescan meet the waste-related challenges resulting from climate change by:

- Identifying strategies to expedite the removal of disaster-related waste during a disaster
- response
- Reduces dangers of fire, personal injury and disease vectors
- Limits number of times waste is handled during cleanup
- Increases probability that waste will be separated into different waste streams,instead of co-mingled into large piles of waste, which facilitates reuse, recycling,treatment and proper disposal of different waste streams
- Evaluating the community’s reuse and recycling program to ensure it can be scaled up tohandle disaster-related wastes
- Maximizes reuse and recycling opportunities available to the community within andacross jurisdictional lines during a disaster
- Maintains a robust and viable reuse and recycling infrastructure, such as recyclingfacilities and end markets for reused and recycled products
- Encourages green building programs
- Finding opportunities for source reduction and hazard mitigation before a disasteroccurs
- Decreases the total amount of waste that may be generated (e.g., by raisingminimum floor/foundation elevations in low-lying areas or updating building coderequirements so that more resilient building materials and strategies that increase abuilding’s capacity to withstand greater wind, rain or snow loads are incorporatedinto building design and construction)
- Eliminates the generation of potentially problematic wastes (e.g., retrofitting PCBtransformers to reduce PCB-contaminated wastes)
- Beginning discussions with waste management facilities (e.g., recycling facilities,landfills) and residents
- Helps ensure their acceptance of disaster-related wastes

9. FINANCIAL AND ECONOMIC ANALYSIS

9.1. FINANCIAL ANALYSIS

9.1.1. Methodology of the analysıs

The **purpose for requiring CBA** for major projects is **twofold**:

First, it must be shown that the project is desirable from an economic point of view and contributes to the goals of EU regional policy. In order to check this, it is necessary to carry out an economic analysis and look at the effect on economic indices estimated by the CBA. A simple rule is that if the project's economic net present value (ENPV) is positive, then the society is better off with the project because its benefits exceed its costs. Therefore, the project should receive the assistance of EU Funds and be co-financed if needed (which will be proved below, in the Financial Analysis). The fact that a project contributes positively to EU regional policy objectives does not necessarily mean that it has to be co-financed by any Structural Fund.

Second, evidence should be provided that the contribution of the EU Fund is needed for the project to be financially viable. The appropriate level of assistance should be determined on this basis. To check whether a project needs co-financing requires a financial analysis. If the financial net present value of the investment without the contribution of the Funds (FNPV/C) is negative then the project can be co-financed; the EU grant should not exceed the amount of money that makes the project break even, so that no over-financing occurs.

In principle, all impacts should be assessed: financial, economic, social, environmental, etc. The objective of CBA is to identify and monetize all possible impacts in order to determine the project costs and benefits; then the results are aggregated (net benefits) and conclusions are drawn on whether the project is desirable and worth implementing. Costs and benefits should be evaluated on an incremental basis, by considering the difference between the project scenario and an alternative scenario without the project (Business as usual scenario – BAU).

In this paragraph, Financial Analysis carried out according to the principles of the Guide to Cost-Benefit Analysis of Investment Projects, Economic Appraisal tool for Cohesion Policy 2014-2020, European Commission, Directorate-General for Regional and Urban policy, December 2014.

The Guide defines the main purpose of the financial analysis is to use the project cash flow forecasts to calculate suitable net return indicators. The Guide places particular emphasis on two financial indicators: the Financial Net Present Value (FNPV) and the Financial Internal Rate of Return (FRR), respectively in terms of return on the investment cost, FNPV(C) and FRR(C), and return on national capital, FNPV(K) and FRR(K).

The methodology used is discounted cash flow (DCF) analysis. There are **two main features of the DCF method**:

Only cash flows are considered. Thus, non-cash accounting items as depreciation and contingency reserves were not included in the DCF analysis. **However,** due to the fact that a risk analysis also carried out in this study, contingencies included in the eligible cost. But this cost category is not included for the determination of the funding gap, as they do not constitute cash flows.

The residual value is calculated on the basis of a design life time of 30 years, by computing the net present value of cash flows in the remaining years of the project after the reference period.

As mentioned above, CBA uses the **incremental method**: the project is evaluated on the basis of the differences in the costs and benefits between the scenario with the project and an alternative scenario without the project.

- The scenario "**without the project"** (BAU Scenario) is that without any infrastructure but only the necessary replacements;
- The scenario **"with the project"** takes into consideration the total cost of investment. Operating costs and revenues considered for the entire infrastructure are those of a scenario of efficient operation.

The financial analysis carried out as part of a major project's CBA aiming to:

- Evaluate the financial profitability of the Project and own (national) capital ;
- Determine the appropriate (maximum) contribution from the EU Fund ;
- Check the financial sustainability of the project.

For the sake of the analysis an excel model developed which covers the demands of the guidelines. The purpose of this tool is to facilitate the calculation of the funding gap as well as the financial and economic performance indicators.

9.1.2. Capex overview

The paragraph describes the total Investments schedule breakdown. The total investment consists of two major parts, the Eligible part and the non-eligible part. The eligible part will be subject of EU co financing with the present will derive from the Funding gap estimation (see below). Non eligible works are not foreseen for the present project.

The Eligible Investment plan includes the following works:

- Construction of transfer stations, includes civil works plant – machinery and mobile equipment;
- Collection equipment includes plant – machinery and mobile equipment;
- Technical Assistance - Supervision during implementation & Publicity Measures;
- Public Utilities (connection of power supply network, water supply network etc);

Procurement of Construction works govern by RED FIDIC procurement will include contingencies 10%.
The following table shows the cost breakdown in constant prices:

Table 9-1: Breakdown of Investment Cost, in Euro (constant price 2017)

Initial project cost	**Eligible**				**Non-eligible**			
(in constant EUR)	**2017**	**2018**	**2019**	**2020**	**2017**	**2018**	**2019**	**2020**
Land acquisition								
Acquisition of land for Transfer Station						0	0	0
Total	**0**	**0**	**0**	**0**		**0**	**0**	**0**
Civil construction								
Transfer Shuto Orizari		194,383	291,574	161,986				
Transfer Station Gazi Baba - Vardarište		173,444	260,166	144,537				
Collection Equipment								
Total	**0**	**367,827**	**551,740**	**306,522**	**0**	**0**	**0**	**0**
Plant and machinery								
Transfer Shuto Orizari				78,450				
Transfer Station Gazi Baba - Vardarište				78,450				
Collection Equipment				2,600,893				
Total	**0**	**0**	**0**	**2,757,793**	**0**	**0**	**0**	**0**
Mobile equipment								
Transfer Shuto Orizari				954,156				
Transfer Station Gazi Baba - Vardarište				516,708				
Collection Equipment				2,905,770				
Total	**0**	**0**	**0**	**4,376,634**	**0**	**0**	**0**	**0**
Contingencies								
Transfer Shuto Orizari	0	19,438	29,157	24,044	0	0	0	0
Transfer Station Gazi Baba - Vardarište	0	17,344	26,017	22,299	0	0	0	0
Collection Equipment	0	0	0	130,045	0	0	0	0
Total	**0**	**36,783**	**55,174**	**176,387**	**0**	**0**	**0**	**0**
Totals excluding intangibles								
Transfer Shuto Orizari	0	213,821	320,731	1,218,635	0	0	0	0
Transfer Station Gazi Baba - Vardarište	0	190,788	286,183	761,993	0	0	0	0
Collection Equipment	0	0	0	5,636,708	0	0	0	0
Total	**0**	**404,609**	**606,914**	**7,617,336**	**0**	**0**	**0**	**0**
Intangible components								
Technical Assistance - Supervision during implementation & Publicity	0	150,000	260,000	260,000				
Public Utilities	100,000	50,000	0	0				
Grand total	**100,000**	**604,609**	**866,914**	**7,877,336**	**0**	**0**	**0**	**0**

During the thirty years analysis period (2017-2046), replacement and reinvestments costs were taken into account. The main parameter for the timing of such investments was the useful life of the assets. The reinvestment cost has been presented as follow:

Table 9-2: Breakdown of Reinvestment Cost, in Euro (constant price 2017)

REINVESTMENT COST **Non Eligible Cost**							
(in constant EUR)	**2021-2026**	**2027**	**2028-2031**	**2032**	**2033-2038**	**2039**	**2040-2046**
Land acquisition							
Acquisition of land of WMC & Transfer Station	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Civil construction							
Transfer Shuto Orizari	0	0	0	0	0	0	0
Transfer Station Gazi Baba - Vardarište	0	0	0		0	0	0
Collection Equipment	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Plant and machinery							
Transfer Shuto Orizari	0	0	0	54,915	0	0	0
Transfer Station Gazi Baba - Vardarište	0	0	0	54,915	0	0	0
Collection Equipment	0	0	0	1,820,625	0	0	0
Total	**0**	**0**	**0**	**1,930,455**	**0**	**0**	**0**
Mobile equipment							
Transfer Shuto Orizari	0	0	0	954,156	0	0	0
Transfer Station Gazi Baba - Vardarište	0	0	0	516,708	0	0	0
Collection Equipment	0	5,225,805	0	2,905,770	0	5,225,805	0
Total	**0**	**5,225,805**	**0**	**4,376,634**	**0**	**5,225,805**	**0**
Contingencies				0			
Transfer Shuto Orizari	0	0	0	5,492	0	0	0
Transfer Station Gazi Baba - Vardarište	0	0	0	5,492	0	0	0
Collection Equipment	0	0	0	91,031	0	0	0
Total	**0**	**0**	**0**	**102,014**	**0**	**0**	**0**
Totals excluding intangibles							
Transfer Shuto Orizari	0	0	0	1,014,563	0	0	0
Transfer Station Gazi Baba - Vardarište	0	0	0	577,115	0	0	0
Collection Equipment	0	5,225,805	0	4,817,426	0	5,225,805	0
Total	**0**	**5,225,805**	**0**	**6,409,104**	**0**	**5,225,805**	**0**
Intangible components							
Technical Assistance & Supervision during implementation							
Public Works							
Grand total	**0**	**5,225,805**	**0**	**6,409,104**	**0**	**5,225,805**	**0**

9.1.3. Opex overview

9.1.3.1. Opex Overview for WITH PROJECT scenario

The operating cost of the project is projected by waste element: collection, transfer and transportation. Within each element the cost is split into fixed and variable to allow for better projection and differentiation of growth rates.

The O&M costs were grouped in the following cost centers:

a. Transfer stations;
b. Transportation costs direct to WMC and to Transfer Stations;
c. Collection cost;

The O&M cost centers consist of fixed and variable costs. The basic assumptions of that distinguish is the relation between cost category and waste quantities.

In the group of variable costs the **energy** and **fuel** costs that are related to the waste quantities are included. Within the group of fixed costs the maintenance cost, the insurance, monitoring costs and the labor cost are included.

The prices considered standard of 2017 for the whole period of analysis.

The unitary costs per each category are as follow:

Maintenance Cost	:	4% of the Mobile Equipment and 2% for civil works;
Fuel cost	:	0.856 €/l;
Energy cost	:	0.140 €/KWh;
Insurance	:	1% of the inv. cost;
Administrative cost	:	20% of the labour cost.
Unskilled Labour Cost	:	4,200 € / year;
Skilled Labour Cost	:	6,120 € / year;
Supervisors etc	:	8,160 € / year;

9.1.3.1.1 Transfer stations

The two (2) transfer stations (Shuto Orizari and Gazi Baba - Vardarište) cost center includes the following cost categories per year

- Labor cost (administrative cost included): 6 drivers and 8 unskilled workers 84,384 €/year (administrative cost included);
- Maintenance and insurance cost : 134,338 € / year;

The quantities of transferred waste on which the calculation of the pure variable cost category of energy and fuel is based, are the average quantities calculated for the whole period of analysis.

- Energy costs (average 2021-2046): 18,000 € / year

- Fuel costs (average 2021-2046): 74,645 € / year

The following table presents the operating cost for the transport of waste from each Transfer Station to Waste Management Center (WMC). The calculations for this operating cost have been presented in chapter 7.

Table 9-3: OPEX per TS (€/t), (average 2021-2046)

Transfer Stations	Recyclables (t/y)	Green waste (t/y)	Total Waste	Unit Cost (€/t)	Total Cost (€/a)
	(t/y)	(t/y)	(t/y)		
TS Shuto Orizari	16,403	3,695	63,193	3.45	217,737
TS Gazi Baba - Vardarište	8,160	1,838	31,438	4.13	129,817
		Total	**94,631**	**3.67**	**347,554**

9.1.3.1.2 Transportation cost direct to WMC and Transportation cost to Transfer Stations

The following table presents the operating cost for the transport of waste directly to WMC (for municipalities Aerodrom, Kisela Voda, Centar, Chair, Sopishte, Zelenikovo and Studenichani) and transportation cost to transfer stations (for municipalities Karposh, Butel, Gjorche Petrov, Saraj, Chucher Sandevo, Shuto Orizari, Gazi Baba, Arachinovo, Ilinden and Petrovets).

Table 9-4: Transportation cost direct to WMC and Transportation cost to Transfer Stations

Waste categories	Waste quantities that must be transferred (average 2021-2046) (t/y)	Unit Cost (€/t)	Total Cost (€/y)
Residual Waste	122,602	7.68	942,195
Recyclables Waste	46,664	10.57	493,350
Green waste	10,512	26.51	278,668
TOTAL	**179,778**	**9.54**	**1,714,213**

9.1.3.1.3 Administrative cost

Administration expenses relate to administration, accounting, office running, and other similar expenses, i.e., the expenses that are not directly related to the operation of the Project. The amount of the expenses is according to the LoWM article 123.

9.1.3.1.4 Operating cost for collection

According to the Regional Waste Management Plan, the collection system will use two bins, one for recyclables (dry bin) and one for mixed waste (wet bin). In addition, green waste will be collected separately and will be led for composting.

In order to calculate the operational collection cost in Skopje Region, information from the completed questionnaires from the municipalities were taken into account. The collection cost is estimated about 5% higher compared to current's cost. The increase in cost is due to the upgrading of provided services (different fleet will collect each type of bin (recyclables and residuals) thus labour and fuel cost are expected to be higher, compared to the current situation).

9.1.3.1.5 Total Operating Cost for the WITH PROJECT scenario

The total operating cost for with project scenario, for the period 2021-2046, according to the above data is presented in the table below:

Table 9-5: Total Operating Cost (€/y) - WITH PROJECT scenario, in constant price 2017

Year	Collection Cost (Residual, recyclables, green)	Operating costs - Transfer Shuto Orizari	Operating costs -Transfer Station Gazi Baba - Vardarište	Operating costs - Transportation direct to WMC and Transfer Station	Administrative Cost	Total Cost
2021	14,221,072	216,070	129,444	1,708,086	187,159	16,461,831
2022	14,357,631	216,276	129,511	1,708,818	188,741	16,600,978
2023	14,495,837	216,485	129,579	1,709,558	190,342	16,741,800
2024	14,635,719	216,696	129,647	1,710,305	191,962	16,884,329
2025	14,777,310	216,909	129,716	1,711,060	193,602	17,028,597
2026	14,922,536	217,120	129,776	1,711,824	195,284	17,176,541
2027	15,069,751	217,335	129,837	1,712,599	196,989	17,326,511
2028	15,218,991	217,553	129,899	1,713,384	198,718	17,478,545
2029	15,370,295	217,774	129,962	1,714,181	200,470	17,632,683
2030	15,523,704	217,998	130,027	1,714,989	202,247	17,788,965
2031	15,627,650	218,053	130,020	1,715,213	203,446	17,894,381
2032	15,732,711	218,110	130,014	1,715,442	222,453	18,018,731
2033	15,838,894	218,169	130,010	1,715,678	223,784	18,126,535
2034	15,946,206	218,230	130,006	1,715,919	225,130	18,235,491
2035	16,054,653	218,292	130,004	1,716,167	226,489	18,345,606
2036	16,143,528	218,289	129,974	1,716,191	227,600	18,435,582
2037	16,233,292	218,287	129,945	1,716,220	228,722	18,526,467
2038	16,323,947	218,288	129,918	1,716,255	229,855	18,618,263
2039	16,415,498	218,289	129,891	1,716,295	231,000	18,710,973
2040	16,507,947	218,293	129,866	1,716,341	232,156	18,804,602
2041	16,583,163	218,240	129,817	1,716,195	233,093	18,880,507
2042	16,659,098	218,189	129,769	1,716,055	234,039	18,957,150
2043	16,735,754	218,139	129,722	1,715,920	234,994	19,034,530
2044	16,813,132	218,091	129,677	1,715,790	264,274	19,140,964
2045	16,891,233	218,045	129,632	1,715,665	265,364	19,219,939
2046	16,954,874	217,953	129,569	1,715,385	266,249	19,284,030

9.1.3.2. Opex Overview for WITHOUT PROJECT scenario

The "WITHOUT PROJECT" scenario is a theoretical approach of prolonging the existing situation of this non-effective waste management system that already exists. The main assumption for the "WITHOUT PROJECT" scenario is that no investment will take place in order to change the capacity and the nature of the works that exist until now.

The operating cost in the “Without Project” case estimated on the base of weighted average historical cost data, considering that **76 Euros per ton** is the approximate cost for collection & transportation for the year 2017 with average growth 0.5%;

The total operating cost for “Without Project” scenario according to the above data is presented in the table below:

Table 9-6: Total Operating Cost (€/y) - WITHOUT PROJECT scenario, in constant price 2017

Year	Collection & transportation Cost (residual & recyclables)
2021	14,565,667
2022	14,703,805
2023	14,843,612
2024	14,985,118
2025	15,128,354
2026	15,274,532
2027	15,422,728
2028	15,572,979
2029	15,725,325
2030	15,879,806
2031	15,983,393
2032	16,088,124
2033	16,194,004
2034	16,301,041
2035	16,409,242
2036	16,497,455
2037	16,586,585
2038	16,676,636
2039	16,767,611
2040	16,859,512
2041	16,933,822
2042	17,008,881
2043	17,084,691

Year	Collection & transportation Cost (residual & recyclables)
2044	17,161,251
2045	17,238,563
2046	17,301,132

9.1.3.3. Incremental Operating Cost

The following table illustrates the forecasted Operating expenses of the system for selected years and for both with and without project cases, in order the incremental OPEX to be calculated.

Table 9-7: Incremental Operating Cost incl. replacements (€/y), in constant price 2017

Year	Operating cost WITH PROJECT	With Project replacements	Operating cost WITHOUT PROJECT	Without Project replacements	Incremental costs, incl. replacements
2021	16,461,831	0	14,565,667	50,000	1,846,164
2022	16,600,978	0	14,703,805	50,000	1,847,172
2023	16,741,800	0	14,843,612	50,000	1,848,188
2024	16,884,329	0	14,985,118	50,000	1,849,212
2025	17,028,597	0	15,128,354	50,000	1,850,243
2026	17,176,541	0	15,274,532	50,000	1,852,009
2027	17,326,511	5,225,805	15,422,728	50,000	7,079,588
2028	17,478,545	0	15,572,979	50,000	1,855,566
2029	17,632,683	0	15,725,325	50,000	1,857,358
2030	17,788,965	0	15,879,806	50,000	1,859,159
2031	17,894,381	0	15,983,393	50,000	1,860,988
2032	18,018,731	6,307,089	16,088,124	50,000	8,187,696
2033	18,126,535	0	16,194,004	50,000	1,882,530
2034	18,235,491	0	16,301,041	50,000	1,884,449
2035	18,345,606	0	16,409,242	50,000	1,886,363
2036	18,435,582	0	16,497,455	50,000	1,888,127
2037	18,526,467	0	16,586,585	50,000	1,889,881
2038	18,618,263	0	16,676,636	50,000	1,891,626
2039	18,710,973	5,225,805	16,767,611	50,000	7,119,168
2040	18,804,602	0	16,859,512	50,000	1,895,090
2041	18,880,507	0	16,933,822	50,000	1,896,685
2042	18,957,150	0	17,008,881	50,000	1,898,269
2043	19,034,530	0	17,084,691	50,000	1,899,839

Year	Operating cost WITH PROJECT	With Project replacements	Operating cost WITHOUT PROJECT	Without Project replacements	Incremental costs, incl. replacements
2044	19,140,964	0	17,161,251	50,000	1,929,713
2045	19,219,939	0	17,238,563	50,000	1,931,376
2046	19,284,030	0	17,301,132	50,000	1,932,897

9.1.4. Cost Implication to the Consumer, Affordability Analysis and Operating revenue forecast

In devising the future tariff in the service area, the principles for setting user charges (tariffs) for solid waste management services need to be taken into account, including: polluter pays principle full cost recovery and affordability issues.

Polluter pays principle

Foremost among the principles for setting user charges for solid waste management services is adherence to the polluter pays principle (PPP). According to PPP, the generators of the waste (polluters) should pay the costs of waste collection, transportation treatment and disposal. Full implementation of the PPP means that the user charges are based on all the MSW management costs. The financial calculations in this feasibility study / CBA assume that PPP is implemented, but in a phase-wise manner in the initial years considering the affordability of households.

Full-cost recovery principle

The principle of full-cost recovery holds that waste tariffs should cover the costs of solid waste management, both the collection, transportation and treatment & disposal of waste. Tariffs should recover the total cost of service, including capital and operating cost, maintenance and financing cost. Full cost recovery means that the operating, maintenance and capital costs (depreciation and debt service) need to be included in the calculation of tariffs.

Affordability

Insofar as possible, solid waste tariffs should be affordable for household customers. The concept of affordability refers to the ability of particular consumer groups to pay for a minimum level of a certain service. Up to now in the country there is no national guideline to determine the affordability threshold concerning waste management.

9.1.4.1 Levelized Unit Cost (LUC/DPC)

In order to calculate the full cost recovery tariff the LUC has been calculated. The index of Levelized Unit Cost (LUC/DPC) expressed in €/t and calculated by dividing the net present value of the facility's net cost flows over the reference period (including the investment and O&M cost, net of revenues from sale of by-products) by the discounted quantity of waste treated in that same period, using a financial discount rate of 4%. This index is presented in “New Guide to cost – benefit analysis of investment project by European Commission, December 2014”.

The following table illustrates the LUC/DPC Cost estimation and the related revenues, for selected years, after imposing of an adequate tariff, as mentioned above.

Table 9-8: LUC/DPC Calculation "With project"

LUC/DPC Calculation With Project	NPV	
Discount rate	4.0%	
Investment Cost Total (reinvestments included)	EUR	17,779,960
Operating Cost	EUR	252,953,266
Revenues	EUR	-
Total Cost	EUR	270,733,227
Total Waste input into the system	t	2,542,503
LUC, Investment	EUR/t.	7
LUC, OM&A	EUR/t.	99
LUC, net OM&A	EUR/t.	99
LUC, Total	EUR/t.	106

9.1.4.2 Affordability analysis – Tariffs

The Polluter Pays Principle (PPP) is one of the principles of Community environmental policy and applies throughout the European Union. The simplest way to implement PPP is to introduce **a full cost recovery waste tariff**, which means a tariff high enough to recover the full costs of services provided, including capital and operating costs as well as management and administrative costs of the system. **(i.e. Tariff is equal to LUC)**

However, according to the "Guidance on the methodology for carrying out Cost-Benefit Analysis", *when the affordability of tariffs is considered, stakeholder may artificially cap the level of charges to avoid a disproportionate financing burden for the users, thus ensuring that the service or good is affordable also for the most disadvantaged groups*.

The minimum requirement is that tariffs should at least cover operating and maintenance costs as well as a significant part of the assets' depreciation. An adequate tariff structure should attempt to maximise the project's revenues before public subsidies, while taking affordability into account.
Moreover, according to the "Application of the Polluter Pays Principle (PPP) in Waste Management Projects" of JASPERS Staff Working Papers, August 2011, it has to be considered that where household income levels are generally low or household income is unevenly distributed, residential waste tariffs can be temporarily set below full cost recovery levels.
Taking into account the aforementioned for the present project, the tariffs to the users of the project are proposed to be as follows:

- Commercial users are considered to cover the total Levelized Unit Cost / DPC since the first year.
- Households, will pay prices which in the first years will cover the operating cost. Gradually the price will be increased and about 2039will cover the Full LUC.

The value of affordability, for the residential users, is calculated as % of the average annual income.

Table 9-9: Waste tariffs and affordability issues in Skopje region

User fees		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Collection & transportation (transfer stations included)															
Residential User fees for Collection & transportation (transfer stations included)	**EUR/t**	**64**	**66**	**70**	**75**	**83,3**	**84,3**	**85,3**	**86,3**	**87,4**	**90,4**	**91,5**	**92,6**	**93,8**	**94,9**
Mechanical Biological Treatment															
Residential User fees for Mechanical Biological Treatment	**EUR/t**	**0**	**0**	**0**	**0**	**29,9**	**29,9**	**30,0**	**30,0**	**30,0**	**30,0**	**30,0**	**30,0**	**30,0**	**30,0**
Landfill disposal															
Residential User fees forLandfill disposal	**EUR/t**	**26**	**26**	**26**	**25**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**
Sorting of Recyclables waste Bin															
Residential User fees for Sorting of Recyclables waste Bin	**EUR/t**	**0**	**0**	**0**	**0**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**
Composting															
Residential User fees for Composting	**EUR/t**	**0**	**0**	**0**	**0**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**
Total Residential User Fees for collection, transportation treatment & disposal	**EUR/t**	**90**	**91**	**96**	**100**	**124**	**125**	**126**	**127**	**128**	**131**	**132**	**133**	**134**	**135**
Average HH income	EUR/HH/Year	8.557	8.642	8.729	8.816	8.904	8.993	9.083	9.174	9.266	9.358	9.452	9.546	9.642	9.738
Collection, Transportation, Treatment & Disposal		**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Waste per person	tonnes	0,22	0,22	0,22	0,23	0,22	0,22	0,22	0,22	0,23	0,23	0,23	0,23	0,23	0,23
Waste per HH	tonnes	0,75	0,76	0,79	0,81	0,78	0,78	0,79	0,79	0,79	0,79	0,79	0,80	0,80	0,80
Tarrifs per person	EUR/cap	19,36	19,91	21,55	23,23	27,59	27,89	28,19	28,49	28,80	29,57	29,90	30,23	30,57	30,91
Tarrifs per HH	EUR/HH	67,77	69,68	75,41	81,31	96,57	97,61	98,66	99,72	100,79	103,49	104,64	105,80	106,98	108,18
waste tarrif as a % of average HH income	%	0,79%	0,81%	0,86%	0,92%	1,08%	1,09%	1,09%	1,09%	1,09%	1,11%	1,11%	1,11%	1,11%	1,11%

(*) Source: Drisla Feasibility study

User fees		2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
Collection & transportation (transfer stations included)																	
Residential User fees for Collection & transportation (transfer stations included)	EUR/t	**96,0**	**99,2**	**101,6**	**102,8**	**104,1**	**105,6**	**106,5**	**106,5**	**106,5**	**106,5**	**106,5**	**106,5**	**106,5**	**106,5**	**106,5**	**106,5**
Mechanical Biological Treatment																	
Residential User fees for Mechanical Biological Treatment	EUR/t	**30,0**	**30,0**	**30,0**	**30,0**	**30,0**	**30,0**	**30,0**	**30,1**	**30,1**	**30,1**	**30,1**	**30,1**	**30,1**	**30,1**	**30,1**	**30,1**
Landfill disposal																	
Residential User fees forLandfill disposal	EUR/t	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**	**6,3**
Sorting of Recyclables waste Bin																	
Residential User fees for Sorting of Recyclables waste Bin	EUR/t	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**	**2,7**
Composting																	
Residential User fees for Composting	EUR/t	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**	**1,4**
Total Residential User Fees for collection, transportation treatment & disposal	EUR/t	**136**	**140**	**142**	**143**	**145**	**146**	**147**	**147**	**147**	**147**	**147**	**147**	**147**	**147**	**147**	**147**
Average HH income	EUR/HH/Year	9.836	9.934	10.033	10.134	10.235	10.337	10.441	10.545	10.651	10.757	10.865	10.973	11.083	11.194	11.306	11.419
Collection, Transportation, Treatment & Disposal		**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**
Waste per person	tonnes	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23
Waste per HH	tonnes	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,80	0,81	0,81	0,81	0,81	0,81
Tarrifs per person	EUR/cap	31,19	31,94	32,51	32,81	33,12	33,49	33,71	33,73	33,75	33,77	33,79	33,81	33,83	33,85	33,87	33,88
Tarrifs per HH	EUR/HH	109,17	111,78	113,77	114,83	115,91	117,23	117,98	118,05	118,12	118,19	118,26	118,33	118,40	118,46	118,53	118,59
waste tarrif as a % of average HH income	%	1,11%	1,13%	1,13%	1,13%	1,13%	1,13%	1,13%	1,12%	1,11%	1,10%	1,09%	1,08%	1,07%	1,06%	1,05%	1,04%

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(*) Source: Drisla Feasibility study

The gate fee for Mechanical Treatment. Sorting of Recyclables waste bin, Composting, and Landfill disposal are taken ffom the Drisla Feasibility Study.

Based on the above tables the total charges are set to reach gradually a peak value of 1.2% of the average disposable household income (starting from a current level 0.8%). The foreseen user fees are structured in a way to secure compliance with the polluter – pay principle in the long run.

9.1.4.3. Revenues WITH PROJECT scenario

The **"revenues"** include the revenues by charging the households, which consist the 81% of this category and the rest 19% are the revenues of the commercial user charges (source: State Statistical Office, No. 5.1.16.08).

Taking into account the aforementioned for the present project, the tariffs to the users of the project are proposed to be as follows:

- Commercial users are considered to cover the total Levelized Unit Cost / DPC since the first year.
- Households, will pay prices which in the first years will cover the operating cost. Gradually the price will be increased and about 2039 will cover the Full LUC.

The prices assumed constant during the analysis period in the level of 2017. The following table illustrates the Total Revenues after the completion of the project construction and start of operation.

Table 9-10: Revenues of "With project" scenario, prices in EUROS (constant price in 2017)

Year	Total Revenues
2021	15,760,153
2022	15,977,822
2023	16,199,301
2024	16,424,671
2025	16,654,016
2026	17,186,535
2027	17,430,663
2028	17,679,390
2029	17,932,820
2030	18,191,059
2031	18,393,143
2032	18,902,879
2033	19,298,573
2034	19,517,221
2035	19,739,343
2036	19,985,601
2037	20,121,818
2038	20,130,410
2039	20,139,528
2040	20,149,165

Year	Total Revenues
2041	20,137,287
2042	20,125,916
2043	20,115,043
2044	20,104,660
2045	20,094,759
2046	20,067,358

9.1.4.4. Revenues WITHOUT PROJECT analysis

As for the present situation related to the "WITHOUT PROJECT" scenario,the revenues are presented in the following table.

Table 9-11: Revenues for WITHOUT PROJECT scenario prices in EUROS (constant price in 2017)

Year	Revenues - user fees collection
2021	13,804,950
2022	14,066,880
2023	14,335,244
2024	14,610,216
2025	14,891,977
2026	15,181,888
2027	15,420,136
2028	15,666,340
2029	15,978,565
2030	16,298,845
2031	16,514,157
2032	16,736,430
2033	16,706,094
2034	16,676,943
2035	16,648,958
2036	16,600,831
2037	16,553,924
2038	16,508,215
2039	16,515,692
2040	16,523,595
2041	16,513,855
2042	16,504,530
2043	16,495,613
2044	16,487,098
2045	16,478,978
2046	16,456,508

9.1.4.5. Incremental Revenues

The table following present the result of incremental revenues, deriving from the comparison (abstract) between those two scenarios.

Table 9-12: Incremental Revenues prices in EUROS (constant price in 2017)

Year	With Project Revenues	Without Project Revenues	Incremental Revenues
2021	15,760,153	13,804,950	1,955,204
2022	15,977,822	14,066,880	1,910,942
2023	16,199,301	14,335,244	1,864,057
2024	16,424,671	14,610,216	1,814,455
2025	16,654,016	14,891,977	1,762,038
2026	17,186,535	15,181,888	2,004,647
2027	17,430,663	15,420,136	2,010,527
2028	17,679,390	15,666,340	2,013,050
2029	17,932,820	15,978,565	1,954,255
2030	18,191,059	16,298,845	1,892,214
2031	18,393,143	16,514,157	1,878,986
2032	18,902,879	16,736,430	2,166,449
2033	19,298,573	16,706,094	2,592,479
2034	19,517,221	16,676,943	2,840,278
2035	19,739,343	16,648,958	3,090,385
2036	19,985,601	16,600,831	3,384,770
2037	20,121,818	16,553,924	3,567,894
2038	20,130,410	16,508,215	3,622,195
2039	20,139,528	16,515,692	3,623,836
2040	20,149,165	16,523,595	3,625,570
2041	20,137,287	16,513,855	3,623,433
2042	20,125,916	16,504,530	3,621,387
2043	20,115,043	16,495,613	3,619,430
2044	20,104,660	16,487,098	3,617,562
2045	20,094,759	16,478,978	3,615,780
2046	20,067,358	16,456,508	3,610,850

9.1.5. Financial return on investment and performance indicators calculation

In this section will estimate the crucial financial performance indicators which prove if the project needs financial contribution from EU Funds.

These indicators are the Financial Net Present Value of the net cash flow of the investment, under financial discount of a rate 4% and the financial rate of Return. The financial discount rate is an interest at which future values are discounted to the present and roughly equals the opportunity cost of capital.

The values will be discounted respectively to 2017 prices. The period of analysis is 30 years which starts from the year 2017 and ends to 2046.

The period 2017 - 2020 is the maturation and construction period of the project. In order to estimate the performance indicators of the investment, the total budget of the project will be considered because all the components of the investments, no matter the financing source, will operate, produce the service, create revenues and costs. Investment costs, reinvestment, residual value, operating costs and revenues will be calculated on incremental base.

Table 9-13: Financial Return of the investment and FRR

FRR/C before EU assistance	**NPV @ 4.0%**
Investment cost (without contingencies)	-8,242,603
Revenues	35,988,917
O&M costs	-35,836,863
Residual value of investments	407,864
PROJECT CASH-FLOW before Community assistance FNPV/C	-7,682,685
FRR/C before Community assistance	**-1.0 %**

The **FNPV/K and FRR/K** before Community assistance is equal to the FNPV/C and FRR/C because assumed that will be used financial sources with zero cost, (EU contribution and National contribution) and no any kind of loans considered.

Before the financial contribution from EU funds, the net present value turns out to negative sign, and of course the FRR/C is lower than the discount rate. That means that the discounted revenues are not sufficient enough to cover the investment cost and the operating costs as well. The indicators above prove that the implementation of the project is not possible if will not be co-financed from other financial sources.

9.1.6. Funding gap calculation

The financial model developed for this project takes into account the EU grant calculation mechanism. The steps followed to determine the EU grant in accordance to the guidelines are presented below:

***Step 1**. Find the funding-gap rate (**R**):*

R = Max EE/DIC

Where,

Max EE is the maximum eligible expenditure = DIC-DNR;

DIC is the discounted investment cost;

DNR is the discounted net revenue = discounted revenues – discounted operating costs + discounted residual value.

***Step 2**.Find the "decision amount" (**DA**), i.e. "the amount to* which *the co-financing rate for the priority axis applies":*

DA = EC*R

Where,

EC is the eligible cost.

***Step 3.**Find the (maximum) **EU grant**:*

EU grant = DA*Max CRpa

Where,

Max CRpa is the maximum co-funding rate fixed for the priority axis in the Commission's decision adopting the operational program.

Three basic elements of the process are:

- Calculation of Eligible Cost (EC),
- Discounted Investment Cost (DIC) and
- Discounted Net Revenue (DNR).

The funding gap calculation is illustrated in the following table:

Table 9-14: Funding gap calculation Prices in Euros

	Main Elements and Parameters	Value Not discounted	Value Discounted (NPV)
1	Reference period (years)	30	
2	Financial discount rate (%), real	4.0%	
3	Total investment cost (in current euro, not discounted)	9,448,860	
4	Total **considered** investment cost (in euro, discounted) (*)		8,242,603
5	Residual value (in euro, not discounted)	1,271,985	
6	Residual value (in euro, discounted)		407,864
7	Revenues (in euro, discounted)		35,988,917
8	Operating costs (in euro, discounted)		35,836,863
9	Net revenue (in euro, discounted) = (7) - (8) + (6)		559,918
10	Eligible expenditure [Art 55 (2)] (in euro, discounted) = (4) - (9)		7,682,685
11	Funding gap rate (%) = (10) / (4)	93.21 %	

(*) Excluding contingencies

9.1.7. Financing Plan for the Investments

After the funding gap estimation, on the eligible amount of **9,448,860 Euros** applied the estimated grand of EU funding as illustrates the follow table.

Table 9-15: EU Contribution

	EU Community Contribution	Value
1.	Eligible costs (in Euro, not discounted) (Section H.1.12 (C))	9,448,860
2.	Funding gap rate (%) = (E.1.2.11)	93.21%
3.	Decision amount, i.e. the "amount to which the co-financing rate for the priority axis applies"	8,807,801
4.	Co-financing rate of the priority axis (estimation) (%)	85.0%
5.	EU contribution (in euro) = (3)*(4)	7,485,951

The EU grant corresponds to the 79.23% (85% * 93.21%) of the investments eligible budget.

The share of National contribution will be Government funds. Taking into account the financial limits per source the financial scheme will be now as following:

Table 9-16: Financing Plan prices in EUROS

Source of total investment costs (Euro)								
	Eligible cost			9.448.860	Ineligible cost			0
Total investment cost [H.1.12.(A)]	Community assistance [85% of H.2.1-3]	Contribution State budget	Beneficiary Contribution (% of b+c+d)	IFI loan to Beneficiary	IFI loan to Beneficiary	Ineligible other: equity contribution	VAT reclaimed	VAT non reclaimed: own financing
a) = b) through i)	b)	c)	d)		f)	g)	h)	i)
9.448.860	7.485.951	1.962.909	0		0	0	0	0

9.1.8. Financial return on national capital and performance indicators

This paragraph presents calculation of financial performance indicators under the proposed financing scheme. These performance indicators reflect the return potential for the national capital, which is the grant contribution by the Fund. The opportunity cost of the EU grant is lower than the 4%; therefore, will provide means for financial leverage to the project.

Table 9-17: Financial Return of National Capital

FRR/C after EU assistance	**NPV @ 4.0%**
PROJECT CASH-FLOW before Community assistance FNPV/C	-7,682,685
Community Assistance	6,530,282
PROJECT CASH-FLOW after Community assistance FNPV/C	-1,152,403
FRR/C after Community assistance	**2.7%**

For the reason mentioned in above paragraph, the **FNPV/K and FRR/Khave the same price** (equal) with the FNPV/C and FRR/C after Community assistance, which represents the return and the financial performances of the National funds.

9.1.9. Financial sustainability reports

The cash flow statement proved that the operation of the system, under the certain assumptions made, will be sustainable during the analysis period. The sustainability precondition, in order the project to be considered as viable, will be fulfilled. In the following table the net cash flow over the years is positive. The following tables illustrate the Income statement and the cash flow table during the period of analysis.

Table 9-18: Income Statement (Profit – Loss account)

		▼▼Historical data▼▼		►►► Projection ►►►													
SKOPJE - Solid Waste Project	**Unit**	**2017**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
INCOME STATEMENT																	
Income statement																	
Operating revenues - user fees	*Th EUR*	0	14,416	15,620	16,676	16,293	16,909	17,485	18,082	18,701	19,341	20,359	21,061	21,789	22,543	23,325	24,056
Sale of recyclables and compost	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other revenues	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUES	***Th EUR***	**0**	**14,416**	**15,620**	**16,676**	**16,293**	**16,909**	**17,485**	**18,082**	**18,701**	**19,341**	**20,359**	**21,061**	**21,789**	**22,543**	**23,325**	**24,056**
	~~*Th EUR*~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
Operating costs - Collection Cost (Residual, Recyclables, Green Waste)	*Th EUR*	0	-12,707	-13,169	-13,880	-14,650	-15,258	-15,712	-16,181	-16,664	-17,162	-17,677	-18,208	-18,756	-19,322	-19,905	-20,439
	Th EUR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating costs - Transfer Shuto Orizari	*Th EUR*	0	0	0	0	0	-232	-237	-242	-247	-252	-257	-263	-268	-274	-280	-285
Operating costs - Transfer Station Gazi Baba - Vardarište	*Th EUR*	0	0	0	0	0	-139	-142	-145	-148	-151	-154	-157	-160	-163	-167	-170
Operating costs - Transportation direct to WMC and to transfer stations	*Th EUR*		0	0	0	0	-1,833	-1,870	-1,908	-1,947	-1,987	-2,028	-2,069	-2,112	-2,155	-2,199	-2,243
Operating costs - Administrative Cost	*Th EUR*	0	0	0	0	0	-201	-207	-212	-219	-225	-231	-238	-245	-252	-259	-266
TOTAL O&M COSTS	***Th EUR***	**0**	**-12,707**	**-13,169**	**-13,880**	**-14,650**	**-17,662**	**-18,167**	**-18,688**	**-19,224**	**-19,776**	**-20,347**	**-20,935**	**-21,541**	**-22,166**	**-22,809**	**-23,403**
EBITDA	***Th EUR***	**0**	**1,709**	**2,451**	**2,796**	**1,643**	**-753**	**-682**	**-606**	**-523**	**-435**	**12**	**126**	**248**	**377**	**516**	**652**
Depreciation	*Th EUR*	0	0	-4	-29	-64	-396	-396	-396	-396	-396	-396	-396	-648	-648	-648	-648
Write-off of bad debts	*Th EUR*			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current portion of investment grants	*Th EUR*			4	29	64	396	396	396	396	396	396	396	396	396	396	396
EBIT	***Th EUR***	**0**	**1,709**	**2,451**	**2,796**	**1,643**	**-753**	**-682**	**-606**	**-523**	**-435**	**12**	**126**	**-5**	**125**	**263**	**400**
Interests	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	-110	-105	-100	-94	-89
Foreign exchange correction	*Th EUR*			0	0	0	0	0	0	0	0	0	0	0	0	0	0
EBT	***Th EUR***	**0**	**1,709**	**2,451**	**2,796**	**1,643**	**-753**	**-682**	**-606**	**-523**	**-435**	**12**	**16**	**-110**	**25**	**169**	**311**
Income tax	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NET INCOME	***Th EUR***	**0**	**1,709**	**2,451**	**2,796**	**1,643**	**-753**	**-682**	**-606**	**-523**	**-435**	**12**	**16**	**-110**	**25**	**169**	**311**
Income tax - Credit for previous years losses	*Th EUR*				0	0	0	0	0	0	0	0	0	0	0	0	0
Dividends	*Th EUR*				0	0	0	0	0	0	0	0	0	0	0	0	0

Table 9-19: Income Statement (Profit – Loss account)

SKOPJE - Solid Waste Project	Unit	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
INCOME STATEMENT																	
Income statement																	
Operating revenues - user fees	*Th EUR*	24,056	25,217	26,260	27,088	27,944	28,859	29,637	30,242	30,861	31,493	32,104	32,728	33,364	34,014	34,677	35,323
Sale of recyclables and compost	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other revenues	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUES	***Th EUR***	**24,056**	**25,217**	**26,260**	**27,088**	**27,944**	**28,859**	**29,637**	**30,242**	**30,861**	**31,493**	**32,104**	**32,728**	**33,364**	**34,014**	**34,677**	**35,323**
	~~*Th EUR*~~	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating costs - Collection Cost (Residual, Recyclables, Green Waste)	*Th EUR*	-20,439	-20,988	-21,552	-22,132	-22,728	-23,311	-23,909	-24,524	-25,155	-25,802	-26,438	-27,090	-27,759	-28,445	-29,149	-29,844
	Th EUR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating costs - Transfer Shuto Orizari	*Th EUR*	-285	-291	-297	-303	-309	-315	-322	-328	-334	-341	-348	-355	-362	-369	-376	-384
Operating costs - Transfer Station Gazi Baba - Vardarište	*Th EUR*	-170	-173	-177	-180	-184	-188	-191	-195	-199	-203	-207	-211	-215	-219	-224	-228
Operating costs - Transportation direct to WMC and to transfer stations	*Th EUR*	-2,243	-2,288	-2,335	-2,382	-2,430	-2,478	-2,528	-2,578	-2,630	-2,683	-2,736	-2,791	-2,846	-2,903	-2,961	-3,019
Operating costs - Administrative Cost	*Th EUR*	-266	-297	-305	-312	-321	-329	-337	-345	-354	-363	-372	-381	-390	-447	-458	-469
TOTAL O&M COSTS	***Th EUR***	**-23,403**	**-24,037**	**-24,665**	**-25,309**	**-25,971**	**-26,621**	**-27,287**	**-27,971**	**-28,672**	**-29,392**	**-30,101**	**-30,827**	**-31,572**	**-32,384**	**-33,168**	**-33,944**
EBITDA	***Th EUR***	**652**	**1,179**	**1,595**	**1,779**	**1,973**	**2,238**	**2,272**	**2,272**	**2,189**	**2,102**	**2,004**	**1,901**	**1,792**	**1,630**	**1,510**	**1,379**
Depreciation	*Th EUR*	-648	-648	-990	-990	-990	-990	-990	-990	-990	-1,311	-1,311	-1,311	-1,311	-1,311	-1,214	-915
Write-off of bad debts	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current portion of investment grants	*Th EUR*	396	396	396	396	396	396	396	396	396	396	396	396	396	396	299	0
EBIT	***Th EUR***	**400**	**927**	**1,000**	**1,184**	**1,379**	**1,644**	**1,677**	**1,677**	**1,595**	**1,187**	**1,089**	**986**	**877**	**716**	**595**	**464**
Interests	*Th EUR*	-89	-578	-549	-519	-487	-454	-419	-381	-342	-300	-257	-211	-173	-133	-91	-47
Foreign exchange correction	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EBT	***Th EUR***	**311**	**349**	**451**	**665**	**891**	**1,190**	**1,259**	**1,296**	**1,253**	**886**	**832**	**775**	**704**	**583**	**504**	**417**
Income tax	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NET INCOME	***Th EUR***	**311**	**349**	**451**	**665**	**891**	**1,190**	**1,259**	**1,296**	**1,253**	**886**	**832**	**775**	**704**	**583**	**504**	**417**
Income tax - Credit for previous years losses	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dividends	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 9-20: Cash - flow Statement

SKOPJE - Solid Waste Project	Unit	▼▼Historical data▼▼ 2017	►►► Projection ►►► 2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CASH-FLOW STATEMENT																
IFI's loan - Project																
Annual disbursements	Th EUR			0	0	0	0	0	0	0	0	0	0	0	0	0
Total disbursements	Th EUR			0	0	0	0	0	0	0	0	0	0	0	0	0
Pending disbursements	Th EUR			0	0	0	0	0	0	0	0	0	0	0	0	0
Loan amortization	Th EUR					0	0	0	0	0	0	0	0	0	0	0
Loan balance	Th EUR			0	0	0	0	0	0	0	0	0	0	0	0	0
Interest	Th EUR					0	0	0	0	0	0	0	0	0	0	0
Commitment fee	Th EUR					0	0	0	0	0	0	0	0	0	0	0
Front-end fee	Th EUR					0	0	0	0	0	0	0	0	0	0	0
Cash-flow statement																
EBITDA	***Th EUR***		**1,709**	**2,451**	**2,796**	**1,643**	**-753**	**-682**	**-606**	**-523**	**-435**	**12**	**126**	**248**	**377**	**516**
Decrease / (Increase) in working capital	Th EUR		0	0	-685	16	-25	-24	-25	-25	-26	-42	-29	-30	-31	-32
FUNDS FROM OPERATIONS	***Th EUR***		**1,709**	**2,451**	**2,110**	**1,659**	**-778**	**-706**	**-630**	**-549**	**-461**	**-30**	**97**	**218**	**346**	**483**
Capital expenditures	Th EUR		-100	-613	-894	-8,286	0	0	0	0	0	0	-6,314	0	0	0
FREE CASH-FLOW	***Th EUR***		**1,609**	**1,838**	**1,216**	**-6,627**	**-778**	**-706**	**-630**	**-549**	**-461**	**-30**	**-6,217**	**218**	**346**	**483**
Grants	Th EUR		100	613	894	8,286	0	0	0	0	0	0	0	0	0	0
Equity contributions	Th EUR		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Disbursements IFI loan (project)	Th EUR		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Disbursements other loans	Th EUR		0	0	0	0	0	0	0	0	0	0	2,000	0	0	0
			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dividend payments	Th EUR		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Income tax payments	Th EUR		0	0	0	0	0	0	0	0	0	0	0	0	0	0
CASH-FLOW BEFORE DEBT SERVICE	***Th EUR***		**1,709**	**2,451**	**2,110**	**1,659**	**-778**	**-706**	**-630**	**-549**	**-461**	**-30**	**-4,217**	**218**	**346**	**483**
Reimbursement of IFI loan (project)	Th EUR		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest payments IFI loan (project)	Th EUR		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Financial fees IFI loan (project)	Th EUR		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reimbursement of other loans	Th EUR		0	0	0	0	0	0	0	0	0	0	-89	-94	-99	-105
Interest payments other loans	Th EUR		0	0	0	0	0	0	0	0	0	0	-110	-105	-100	-94
Reimbursement revolving credit	Th EUR		0	0	0	0	0	0	0	0	0	0	0	0	0	0
SURPLUS / (DEFICIT) FOR THE YEAR	***Th EUR***		**1,709**	**2,451**	**2,110**	**1,659**	**-778**	**-706**	**-630**	**-549**	**-461**	**-30**	**-4,416**	**18**	**147**	**284**
Drawdowns revolving credit	Th EUR		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest on revolving credit	Th EUR		0	0	0	0	0	0	0	0	0	0	0	0	0	0
NET CASH-FLOW	***Th EUR***		**1,709**	**2,451**	**2,110**	**1,659**	**-778**	**-706**	**-630**	**-549**	**-461**	**-30**	**-4,416**	**18**	**147**	**284**
Cash in hand at the end of the year	Th EUR		1,709	4,160	6,271	7,930	7,152	6,446	5,816	5,267	4,806	4,776	360	378	525	809
				OK												

Table 9-21: Cash - flow Statement

SKOPJE - Solid Waste Project	Unit	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
INCOME STATEMENT																	
Income statement																	
Operating revenues - user fees	*Th EUR*	24,056	25,217	26,260	27,088	27,944	28,859	29,637	30,242	30,861	31,493	32,104	32,728	33,364	34,014	34,677	35,323
Sale of recyclables and compost	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other revenues	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUES	***Th EUR***	**24,056**	**25,217**	**26,260**	**27,088**	**27,944**	**28,859**	**29,637**	**30,242**	**30,861**	**31,493**	**32,104**	**32,728**	**33,364**	**34,014**	**34,677**	**35,323**
Operating costs - Collection Cost (Residual, Recyclables, Green Waste)	*Th EUR*	-20,439	-20,988	-21,552	-22,132	-22,728	-23,311	-23,909	-24,524	-25,155	-25,802	-26,438	-27,090	-27,759	-28,445	-29,149	-29,844
	Th EUR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating costs - Transfer Shuto Orizari	*Th EUR*	-285	-291	-297	-303	-309	-315	-322	-328	-334	-341	-348	-355	-362	-369	-376	-384
Operating costs - Transfer Station Gazi Baba - Vardarište	*Th EUR*	-170	-173	-177	-180	-184	-188	-191	-195	-199	-203	-207	-211	-215	-219	-224	-228
Operating costs - Transportation direct to WMC and to transfer stations	*Th EUR*	-2,243	-2,288	-2,335	-2,382	-2,430	-2,478	-2,528	-2,578	-2,630	-2,683	-2,736	-2,791	-2,846	-2,903	-2,961	-3,019
Operating costs - Administrative Cost	*Th EUR*	-266	-297	-305	-312	-321	-329	-337	-345	-354	-363	-372	-381	-390	-447	-458	-469
TOTAL O&M COSTS	***Th EUR***	**-23,403**	**-24,037**	**-24,665**	**-25,309**	**-25,971**	**-26,621**	**-27,287**	**-27,971**	**-28,672**	**-29,392**	**-30,101**	**-30,827**	**-31,572**	**-32,384**	**-33,168**	**-33,944**
EBITDA	***Th EUR***	**652**	**1,179**	**1,595**	**1,779**	**1,973**	**2,238**	**2,272**	**2,272**	**2,189**	**2,102**	**2,004**	**1,901**	**1,792**	**1,630**	**1,510**	**1,379**
Depreciation	*Th EUR*	-648	-648	-990	-990	-990	-990	-990	-990	-990	-1,311	-1,311	-1,311	-1,311	-1,311	-1,214	-915
Write-off of bad debts	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current portion of investment grants	*Th EUR*	396	396	396	396	396	396	396	396	396	396	396	396	396	396	299	0
EBIT	***Th EUR***	**400**	**927**	**1,000**	**1,184**	**1,379**	**1,644**	**1,677**	**1,677**	**1,595**	**1,187**	**1,089**	**986**	**877**	**716**	**595**	**464**
Interests	*Th EUR*	-89	-578	-549	-519	-487	-454	-419	-381	-342	-300	-257	-211	-173	-133	-91	-47
Foreign exchange correction	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EBT	***Th EUR***	**311**	**349**	**451**	**665**	**891**	**1,190**	**1,259**	**1,296**	**1,253**	**886**	**832**	**775**	**704**	**583**	**504**	**417**
Income tax	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NET INCOME	***Th EUR***	**311**	**349**	**451**	**665**	**891**	**1,190**	**1,259**	**1,296**	**1,253**	**886**	**832**	**775**	**704**	**583**	**504**	**417**
Income tax - Credit for previous years losses	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dividends	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 9-22: Balance Sheet

		▼▼Historical data▼▼		►►► Projection ►►►													
SKOPJE - Solid Waste Project	**Unit**	**2017**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
BALANCE SHEET																
Balance sheet																
Gross fixet assets (existing assets)	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
less depreciation (existing assets)	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross fixet assets (project assets)	*Th EUR*	0	100	713	1,607	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893
less depreciation (project assets)	*Th EUR*	0	0	-4	-33	-97	-493	-888	-1,284	-1,680	-2,075	-2,471	-2,867	-3,263	-3,658	-4,054
Gross fixet assets (other CAPEX)	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	6,314	6,314	6,314	6,314
less depreciation (other CAPEX)	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	-253	-505	-758
NET FIXED ASSETS	***Th EUR***	**0**	**100**	**709**	**1,575**	**9,796**	**9,400**	**9,005**	**8,609**	**8,213**	**7,818**	**7,422**	**13,340**	**12,692**	**12,044**	**11,395**
Stocks	*Th EUR*	0	0	0	1,371	1,339	1,390	1,437	1,486	1,537	1,590	1,673	1,731	1,791	1,853	1,917
Accounts receivable and other current assets	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash in hand	*Th EUR*	0	1,709	4,160	6,271	7,930	7,152	6,446	5,816	5,267	4,806	4,776	360	378	525	809
CURRENT ASSETS	***Th EUR***	**0**	**1,709**	**4,160**	**7,642**	**9,269**	**8,542**	**7,883**	**7,302**	**6,804**	**6,396**	**6,449**	**2,091**	**2,169**	**2,378**	**2,726**
TOTAL ASSETS	***Th EUR***	**0**	**1,809**	**4,870**	**9,216**	**19,065**	**17,942**	**16,888**	**15,911**	**15,018**	**14,213**	**13,871**	**15,431**	**14,861**	**14,422**	**14,122**
Shareholders' contributions	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Retained earnings	*Th EUR*	0	1,709	4,160	6,956	8,600	7,847	7,165	6,559	6,036	5,601	5,613	5,629	5,518	5,543	5,712
EQUITY	***Th EUR***	**0**	**1,709**	**4,160**	**6,956**	**8,600**	**7,847**	**7,165**	**6,559**	**6,036**	**5,601**	**5,613**	**5,629**	**5,518**	**5,543**	**5,712**
Investment grants	*Th EUR*	0	100	713	1,607	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893
less transfers to income statement	*Th EUR*	0	0	-4	-33	-97	-493	-888	-1,284	-1,680	-2,075	-2,471	-2,867	-3,263	-3,658	-4,054
Loans	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	1,911	1,817	1,717	1,612
Bank overdraft	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts payable and other current liabilites	*Th EUR*	0	0	0	685	670	695	719	743	769	795	837	866	895	926	959
Taxes and dividends	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIABILITIES	***Th EUR***	**0**	**100**	**709**	**2,260**	**10,466**	**10,095**	**9,723**	**9,352**	**8,982**	**8,612**	**8,258**	**9,802**	**9,342**	**8,878**	**8,410**
TOTAL EQUITY AND LIABILITIES	***Th EUR***	**0**	**1,809**	**4,870**	**9,216**	**19,065**	**17,942**	**16,888**	**15,911**	**15,018**	**14,213**	**13,871**	**15,431**	**14,861**	**14,422**	**14,122**
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 9-23: Balance Sheet

SKOPJE - Solid Waste Project	Unit	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
BALANCE SHEET																	
Balance sheet																	
Gross fixet assets (existing assets)	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
less depreciation (existing assets)	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross fixet assets (project assets)	*Th EUR*	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893
less depreciation (project assets)	*Th EUR*	-4,450	-4,845	-5,241	-5,637	-6,033	-6,428	-6,824	-7,220	-7,615	-8,011	-8,407	-8,803	-9,198	-9,594	-9,893	-9,893
Gross fixet assets (other CAPEX)	*Th EUR*	6,314	14,864	14,864	14,864	14,864	14,864	14,864	14,864	22,872	22,872	22,872	22,872	22,872	22,872	22,872	22,872
less depreciation (other CAPEX)	*Th EUR*	-1,010	-1,263	-1,857	-2,452	-3,047	-3,641	-4,236	-4,830	-5,425	-6,340	-7,254	-8,169	-9,084	-9,999	-10,914	-11,829
NET FIXED ASSETS	***Th EUR***	**10,747**	**18,649**	**17,658**	**16,668**	**15,678**	**14,688**	**13,697**	**12,707**	**19,725**	**18,414**	**17,103**	**15,793**	**14,482**	**13,172**	**11,958**	**11,043**
Stocks	*Th EUR*	1,977	2,073	2,158	2,226	2,297	2,372	2,436	2,486	2,537	2,588	2,639	2,690	2,742	2,796	2,850	2,903
Accounts receivable and other current assets	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash in hand	*Th EUR*	1,232	1,718	2,174	2,823	3,665	4,770	5,914	7,065	125	1,105	1,987	2,966	3,835	4,542	5,128	5,584
CURRENT ASSETS	***Th EUR***	**3,210**	**3,791**	**4,333**	**5,050**	**5,962**	**7,142**	**8,350**	**9,551**	**2,661**	**3,693**	**4,626**	**5,656**	**6,577**	**7,338**	**7,978**	**8,487**
TOTAL ASSETS	***Th EUR***	**13,957**	**22,440**	**21,991**	**21,718**	**21,640**	**21,830**	**22,047**	**22,258**	**22,386**	**22,107**	**21,729**	**21,448**	**21,060**	**20,509**	**19,936**	**19,530**
Shareholders' contributions	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Retained earnings	*Th EUR*	6,023	6,372	6,823	7,489	8,380	9,570	10,828	12,124	13,377	14,263	15,095	15,870	16,575	17,157	17,661	18,078
EQUITY	***Th EUR***	**6,023**	**6,372**	**6,823**	**7,489**	**8,380**	**9,570**	**10,828**	**12,124**	**13,377**	**14,263**	**15,095**	**15,870**	**16,575**	**17,157**	**17,661**	**18,078**
Investment grants	*Th EUR*	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893	9,893
less transfers to income statement	*Th EUR*	-4,450	-4,845	-5,241	-5,637	-6,033	-6,428	-6,824	-7,220	-7,615	-8,011	-8,407	-8,803	-9,198	-9,594	-9,893	-9,893
Loans	*Th EUR*	1,502	9,984	9,437	8,860	8,251	7,609	6,932	6,217	5,463	4,668	3,829	3,143	2,419	1,655	850	0
Bank overdraft	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accounts payable and other current liabilites	*Th EUR*	989	1,036	1,079	1,113	1,148	1,186	1,218	1,243	1,268	1,294	1,319	1,345	1,371	1,398	1,425	1,452
Taxes and dividends	*Th EUR*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIABILITIES	***Th EUR***	**7,934**	**16,067**	**15,168**	**14,229**	**13,260**	**12,260**	**11,219**	**10,133**	**9,009**	**7,844**	**6,634**	**5,578**	**4,485**	**3,352**	**2,275**	**1,452**
TOTAL EQUITY AND LIABILITIES	***Th EUR***	**13,957**	**22,440**	**21,991**	**21,718**	**21,640**	**21,830**	**22,047**	**22,258**	**22,386**	**22,107**	**21,729**	**21,448**	**21,060**	**20,509**	**19,936**	**19,530**
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

9.2. ECONOMIC ANALYSIS

9.2.1. Methodology of the analysıs

According to the EU Regulations for major projects under the regional development component it’s obligatory that: “*When submitting a major project to the Commission, the operating structure shall provide (…) an assessment of the overall socio-economic balance of the operation, based on a cost-benefit analysis (…), on the socio-economic situation of the beneficiary country* …”

Contrary to the financial analysis, which was made on behalf of the owner of the infrastructure, the economic analysis is made on behalf of the whole society and appraises the project’s contribution to the economic welfare of the region or country. It relies on the fact that observed market prices of inputs and outputs are often distorted and do not mirror their social value (i.e. their social opportunity cost), hence the use of accounting shadow prices. In addition, investment projects often have impacts that have no direct market values (i.e. impacts on the environment). These effects monetized through different valuation techniques depending on the nature of the effect considered.

The key objective of the economic analysis is to prove that the present value of the project’s economic benefits exceed the present value of its economic costs, which means that the project has a positive net contribution to society, and is therefore worth being co-financed by EU funds. This is expressed as a positive Economic Net Present Value of the net cash flow, a Benefit / Cost (B/C) ratio higher than 1.0, or a project’s economic rate of return (ERR) exceeding the social discount rate (5% in this case). The starting point for calculation of these indicators was the financial cash flows from the financial analysis (paragraph 9.1).

The objective of the analysis is to test the project’s contribution to the regional social and economic development by comparing the benefits to the investment cost. On the other hand it is a commonly acceptable fact that to analyze the above mentioned benefits on a quantitative basis is extremely difficult which requires detailed field surveys and thus they are outside the assignment of the study.

The methodological guidelines in the EC CBA Guide have been used during the analysis of the benefits, which are mainly social, environmental health and local economic development. The Guide proposes the following five steps for the economic evaluation of the projects:

The following five methodological steps for the economic evaluation of the project applied:

- conversion of market to accounting prices;
- monetization of non-market impacts;
- inclusion of additional indirect effects;
- discounting of the estimated costs and benefits and,
- calculation of the economic performance indicators (economic net present value, economic rate of return and B/C ratio).

The economic analysis is based on incremental approach, comparing economic cost and benefits (impacts) of the project with the situation without project. It is carried through in constant 2017 prices and uses a social discount rate of 5%. The quantification of economic cost and benefits relies on generally accepted principles. Costs are transformed from financial to economic terms through fiscal and externalities corrections and conversion of distorted market prices to accounting prices. Benefits consist mainly (but not exclusively) of positive externalities arising from the compliance with EU environmental standards (by improving quality of life, sanitary and health conditions, etc.).

As mentioned above, economic analysis assesses whether the project has a positive net contribution to society and thus deserves co-financing by EU funds. A selected project alternative increases economic welfare when its economic and social benefits exceed its costs and that is expressed by the Economic Net Present Value (ENPV). The ENPV is based on the flows of economic benefits and costs. The ***economic benefits*** are the cost savings achieved by the project, ***plus external effects*** such as reductions in emissions to the atmosphere. ***External effects*** are assessed at economic prices, which reflect their value to society. Future benefits and costs are discounted to the present using a social discount rate of 5%. In the economic analysis taxes and other transfers represent no net benefit to society, as they are a cost to one entity and revenue to another.

The economic analysis takes the incremental financial flows as its starting point. It then removes transfers, adds external benefits and subtracts external costs, and finally, if required, it introduces conversion factors to correct perceived price distortions.

As regards transfers, VAT was excluded a priori. Other transfers to be removed from the estimates used in financial analysis are social surcharges on salaries, as well as any penalties for non-compliance with environmental legislation. It is worth noting that the removal of these two types of transfers should not change the ranking of options.

Concerning external effects, the with-project scenario has higher processing and environmental protection costs.

Regarding price distortions, a standard conversion factor and a shadow wage rate were applied.

9.2.2. Analysıs of the socioeconomic costs

Price distortions on means of production

Shadow prices arise when distortions occur in a given market, which lead to the costs of a factor of production being different to the cost that society incurs. Market distortions may be caused by the existence of a monopoly, quotas and price regulation.

Conversion Factors (CF)

For an open economy with international tenders for procuring construction, equipment, materials and services, traded items will normally cover most of the project costs.

No specific conversion is required since market prices are assumed to reflect economic prices.

For non-traded items (such as goods and services that have to be procured domestically), the conversion from financial to economic prices is usually done through conversion factors, if available.
When specific sectoral conversion factors are not available, a Standard Conversion Factor (SCF) is used by default based on the average differences between domestic and international prices, due to trade tariffs and barriers. It can be estimated based on foreign trade statistics using the following formula:

SCF = (M + X)/ ((M + Tm) + (X - Tx))
Where:
M = value of total imports
X = value of total exports
Tm = import taxes
Tx = export taxes

Shadow Wages Distortions

A waste investment project will usually generate employment during the design and build phase, as well as during the operational phase. However, jobs created by the project cannot be counted as a benefit because wages are already counted as part of the costs of the project.
The skilled labor component of the project is considered a scarce resource and therefore is adequately priced on the market in terms of opportunity cost. No specific conversion is required.
On the contrary, in the context of high unemployment, non-skill labor will not be adequately priced by the market from an economic point of view. The correction to reflect the opportunity cost of labor is usually made by multiplying the financial cost of unskilled workers by the, so-called, Shadow Wage Rate Factor (SWRF), which can be calculated as (1-u)*(1-t), where u is the regional unemployment rate and t is the rate of social security payments and relevant taxes included in the labor costs.

This corresponds to a Shadow Wage of:
SW=FW*(1-u)*(1-t),
Where FW being the financial (or market) wage.
In the case of the project and its characteristics, the SCF is estimated as follows:
In this analysis, costs for investment and for O&M are valued differently from their financial values. The cost composition and the conversion of financial costs to economic ones is summarized in table below:

Table 9-24: Breakdown of costs and factors for conversion of financial to economic costs

Break-down of costs (excluding land adquisition)		Construction	Operation	ConvFactor	ConvFactor
Traded goods	%	20%	15%	1.00	1.00
Non-traded goods	%	10%	5%	0.90	0.90
Skilled Labour	%	20%	25%	1.00	1.00
Unskilled Labour	%	35%	40%	1.00	0.54
Transfer payments	%	15%	15%	0.00	0.00
Total (%)		**100%**	**100%**		

The conversion factors applied to the Economic Analysis are:

B1. According to the official statistical data about unemployment rate in the region was the recent year about 25.70%.

B2. Taking into account that the average sum for social security payments and relevant taxes are included in the labor costs is about 27% on the gross salary.

The Conversion Factor for non-skilled employment cost is **estimated at 0.54**

C. CF for Non traded goods

The CF for those categories of goods and services is **estimated at 0.90.**

9.2.3. Analysıs OF THE SOCIOECONOMIC BENEFITS

The project economic benefits for the current project can be grouped into three main categories: (a) avoided GHG emmisions, b) travel time savings; (c) Vehicle operating costs (VOC) and (d) Reduction of disamenities impacts from uncollected waste.

The different standard values proposed for the quantification of the economic benefits have been taken from the three documents listed below. The specific sections of these documents that were used as a reference are indicated when discussing each one of the specific benefits.

1. Calculation of GHG Emissions in Waste and Waste-to-Energy Projects, Dorothee Teichmann & Christian Schempp, November 2013 (revised version). JASPERS Knowledge Economy and Energy Division, Staff Working Papers
2. Guidelines for Cost Benefit Analysis of Solid Waste projects supported by the Cohesion Fund and the European Regional Development Fund in 2007-2013, Jaspers May 2009
3. Guide to Cost benefit Analysis of investment Projects, 2014-2020
4. Costs for Municipal Waste Management in the EU, prepared by EUNOMIA RESEARCH AND CONSULTING in 2001 for the European Commission, DG Environment.
5. Study on the Economic Valuation of Environmental Externalities from Landfill Disposal and Incineration of Waste, October 2000 , European Commission, DG Environment.
6. Waste Management Options and Climate Change (ISBN 92-894-1733-1) prepared by AEA Technology in July 2001 for the European Commission, DG Environment.

The specific methodology for the quantification of the economic benefits are according to the Guidelines for Cost Benefit Analysis of Solid Waste projects supported by the Cohesion Fund and the European Regional Development Fund in 2007-2013, Jaspers May 2009. The specific assumptions made for the calculation are described below:

a. Avoided GHG emissions through improved transportation. In order to quantify GHG emissions released and avoided in the waste management system, the system is separated into its individual components, that is facilities for example:
   - transfer station
   - transportation to transfer station
   - transportation to WMC

   Specific emission factors taken from the literature are applied to calculate the GHG emissions that are characteristic for the individual processes that take place in these facilities and described **in chapter 8.** The volumes of Greenhouse Gas (GHG) were assessed in the with and without project scenarios utilizing JASPERS Knowledge Economy and Energy Division, Staff Working Papers, Calculation of GHG Emissions in Waste and Waste-to-Energy Projects, Dorothee Teichmann & Christian Schempp, November 2013 (revised version).

b. Travel time savings (in hour saved per person) are quantified with the help of the transportation model on the basis of average speeds achieved by trucks with transfer station and without transfer station. As a consequence of the project, it is estimated that the trucks will save around 1h per tone of waste. To monetize the VoT the following assumption have been used:
   - Average occupancy per truck: 3 person
   - Average labour cost per person: 6.2EURO/h
   - Value of time, work trips for (3person per trip)estimated at 18.6EURO/h
   - Escalation factor for VOT: 1%

c. Vehicle operating costs (VOC) savings are calculated by taking into consideration the vehicle operation with the transfer stations and without transfer stations. The labour cost has been excluded to avoid double-counting.

d. The reduction of disammenities impacts from uncollected waste (noise, dust, odours and the presence of vermin) which quantified as 5€/t .

9.2.4. ECONOMIC PERFORMANCE INDICATOR

The incremental economic analysis performed, based in the above mentioned assumptions and calculations. The economic discount rate applied was 5%. The benefits transferred to social values as well as the costs (construction, O&M). The inflows estimated **1.66** times more than the economic outflows, which means the project produces positive added value to the society. More specific the Net Present Value of the Economic flows is **17,057,800 Euros** and the Economic Rate of Return is much higher than the economic discount rate. Calculation of economic performance indicators under the above mentioned assumptions are presenting below:

Table 9-25: Economic performance indicators

FLOWS - ECONOMIC ANALYSIS	NPV
Total Economic Inflows (Inc.)	**42,993,881**
Reduction of visual disamenities, odours and health risk	10,909,934
Reduction of greenhouse gas emissions	63,299
Total Time Cost Savings	24,106,493
Vehicle Operating Cost Savings	7,914,154
Total Economic Outflows (Inc.)	**-25,936,081**
Investments Economic cost	**-5,248,612**
Traded goods	-1,544,081
Non-traded goods	-694,836
Skilled Labour	-1,544,081
Unskilled Labour	-1,465,615
O&M economic costs	**-20,687,469**
Traded goods	-4,687,805
Non-traded goods	-1,406,340
Skilled Labour	-7,813,009
Unskilled Labour	-6,780,315
Economic Net Present Value	**17,057,800**
Economic Rate of Return	**27.1%**
B/C ratio	**-1.66**

The ENPV/C is positive, which indicates that the project is worthwhile for society. The Economic International Rate of Return (EIRR/C) is defined as the discount rate which results in the ENPV/C = 0. The ERR/C is well above the cut-off rate of 5%, which mirrors the positive ENPV/C and underlines that the project is beneficial for society.

The positive sign of ENPV which leads the ERR in value much higher than the social discount rate (the Economic Rate of Return is defined as the discount rate which results in the ENPV to zero price) and the ratio Benefits to Costs higher than 1 proves that the investment for this project adds to the society welfare and is worthy to be financed from National and European funds.

9.3. RISK ASSESSMENT

9.3.1. METHODOLOGY

As set out in Article 101 (Information necessary for the approval of a major project) of Regulation (EU) No 1303/2013, a risk assessment must be included in the CBA. This is required to deal with the uncertainty that always permeates investment projects, including the risk that the adverse impacts of climate change may have on the project. The recommended steps for assessing the project risks are as follows:

- sensitivity analysis (identification of critical variables, elimination of deterministically dependent variables, elasticity analysis, choice of critical variables) ;
- Definition of probability distribution for critical variables ;
- Risk analysis on FNPV/K and on ENPV (Calculation of the distribution of the performance indicator (typically FNPV and ENPV) ;
- Assessment of acceptable levels of risks;
- Recommended actions for prevention of risks.

9.3.2. SENSITIVITY ANALYSIS

Sensitivity analysis enables the identification of the critical variables of the project. Such variables are those whose variations, be their positive or negative, have the largest impact on the project's financial - economic performance. The analysis is carried out by varying one variable at a time and determining the effect of that change on the NPV. As a guiding criterion, the recommendation is to consider critical those variables for which a variation of ±1 % of the value adopted in the base case gives rise to a variation of more than 1 % in the value of the NPV. The tested variables should be deterministically independent and as disaggregated as possible.

A particularly relevant component of the sensitivity analysis is the calculation of the **switching values**. This is the value that the analyzed variable would have to take in order for the NPV of the project to become zero, or more generally, for the outcome of the project to fall below the minimum level of acceptability. The use of switching values in sensitivity analysis allows making some judgements on the risk of the project and the opportunity of undertaking risk-preventing actions.

Moreover, sensitivity analysis repeated to the variables according to the new CBA guide, for a variation of ±1 %):

i. Quantity of waste delivered to the plant
ii. Maintenance Cost
iii. Fuel Cost
iv. Investment Cost
v. Reduction of EU funds
vi. Value of Time
vii. Vehicle Operating Cost Savings
viii. CO_2 price per tonne
ix. Disamenities from uncollected waste

The following table present the results of these calculations:

Table 9-26: Sensitivity analysis

CATEGORIES OF VARIABLES	CHANGE	FNPV/K	ERR	DIFFERENCE ON FNPV/K	DIFFERENCE ON ERR	CRITICAL VARIABLE
BASE	**0.0%**	**-1,152,403**	**27.14%**			
Quantity of waste delivered to the plant						
Quantity of waste delivered to the plant	**0.0%**	**-1,152,403**	**27.14%**			YES
	1.0%	-1,154,729	27.51%	0.20%	1.36%	
	-1.0%	-1,150,077	26.77%	-0.20%	-1.36%	
Maintenance Cost						
Maintenance Cost	**0.0%**	**-1,152,403**	**27.14%**			NO
	1.0%	-1,158,574	27.05%	0.54%	-0.34%	
	-1.0%	-1,146,231	27.23%	-0.54%	0.34%	
Fuel cost						
Fuel cost	**0.0%**	**-1,152,403**	**27.14%**			NO
	1.0%	-1,155,743	27.11%	0.29%	-0.10%	
	-1.0%	-1,149,062	27.17%	-0.29%	0.10%	
Investment Cost						
Investment Cost	**0.0%**	**-1,152,403**	**27.14%**			YES
	1.0%	-1,160,864	26.86%	0.73%	-1.03%	
	-1.0%	-1,143,942	27.42%	-0.73%	1.03%	
Reduction of EU funds						
Reduction of EU funds	**0.0%**	**-1,152,403**	**27.14%**			YES
	-1.0%	-1,217,706	27.14%	5.67%	0.00%	
Value of Time						
Value of Time	**0.0%**	**-1,152,403**	**27.14%**			NO
	1.0%	-1,152,403	27.41%	0.00%	0.99%	
	-1.0%	-1,152,403	26.87%	0.00%	-0.99%	
Vehicle Operating Cost Savings						
Vehicle Operating Cost Savings	**0.0%**	**-1,152,403**	**27.14%**			NO
	1.0%	-1,152,403	27.23%	0.00%	0.35%	
	-1.0%	-1,152,403	27.05%	0.00%	-0.35%	
CO2 price per tonne						
						NO
CO2 price per tonne	**0.0%**	**-1,152,403**	**27.14%**			

CATEGORIES OF VARIABLES	CHANGE	FNPV/K	ERR	DIFFERENCE ON FNPV/K	DIFFERENCE ON ERR	CRITICAL VARIABLE
	1.0%	-1,152,403	27.14%	0.00%	0.0024%	
	-1.0%	-1,152,403	27.14%	0.00%	-0.0024%	
Disamenities from uncollected waste						
Disamenities from uncollected waste	**0.0%**	**-1,152,403**	**27.14%**			NO
	1.0%	-1,152,403	27.27%	0.00%	0.48%	
	-1.0%	-1,152,403	27.01%	0.00%	-0.48%	

Table 9-27: Sensitivity analysis - switching values for critical variables

	Variable	Switching value	
1	Quantity of waste delivered to the plant	Maximum increase before the FNPV/K equals 0	Always Negative
		Maximum decrease before the ENPV equals 0	-52.54%
2	Maintenance Cost	Maximum decrease before the FNPV/K equals 0	Always Negative
		Maximum increase before the ENPV equals 0	220.14%
3	Fuel cost	Maximum decrease before the FNPV/K equals 0	Always Negative
		Maximum increase before the ENPV equals 0	709.83%
4	Investment Cost	Maximum decrease before the FNPV/K equals 0	Always Negative
		Maximum increase before the ENPV equals 0	244.20%
5	Reduction of EU funds	Maximum decrease before the FNPV/K equals 0	Not applicable
		Maximum increase before the ENPV equals 0	Not applicable
6	Value of Time	Maximum increase before the FNPV/K equals 0	Not applicable
		Maximum decrease before the ENPV equals 0	-70.76%
7	Vehicle Operating Cost Savings	Maximum increase before the FNPV/K equals 0	Not applicable
		Maximum decrease before the ENPV equals 0	-215.54%
8	CO_2 price per tonne	Maximum increase before the FNPV/K equals 0	Not applicable
		Maximum decrease before the ENPV equals 0	-26947.77%
9	Disamenities from uncollected waste	Maximum increase before the FNPV/K equals 0	Not applicable
		Maximum decrease before the ENPV equals 0	Always possitive

9.3.3. RISK ANALYSIS

In order Risk Analysis to be performed, has been used the Monte Carlo simulation method. This simulation analyze a range of variation of the main project parameters (investment cost, revenues, O&M costs, economic benefits, economic cost of the investments and economic cost of the operation and maintenance of the resulting facilities).

For each variable a minimum and maximum value is set (as % to the base case) has been entered as follows.

Table 9-28: Risk analysis - parameters considered in the analysis

	Variable	Range of variation from base case	
		Lower	Upper
1	Project investment cost	-5.00%	30.00%
2	Revenues	-30.00%	5.00%
3	O&M costs	-5.00%	30.00%
4	Economic benefits	-30.00%	5.00%
5	Economic costs (Investment)	-5.00%	30.00%
6	Economic costs (O&M)	-5.00%	30.00%

The number of iterations used for the Monte Carlo Simulation was limited to 25,000

Table 9-29: Risk analysis - results of the Monte Carlo analysis

	Variable	FNPV/K	ENPV
1	Expected value	-11.149.240	8.456.343
2	Standard deviation	3.006.405	2.819.440

The following figures illustrate the distribution of probabilities as estimated of the Monte Carlo Simulation:

Figure 9-1: Distribution of FNPV/k values

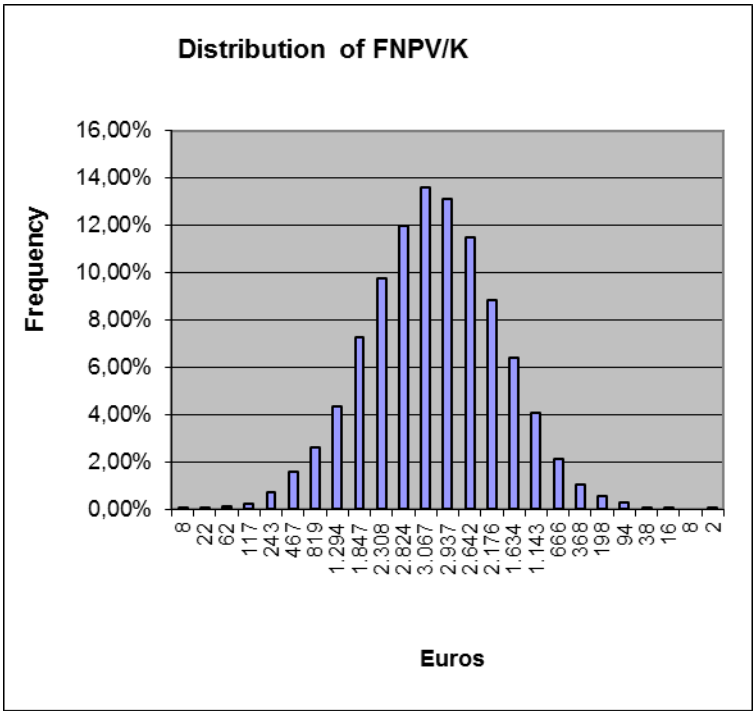
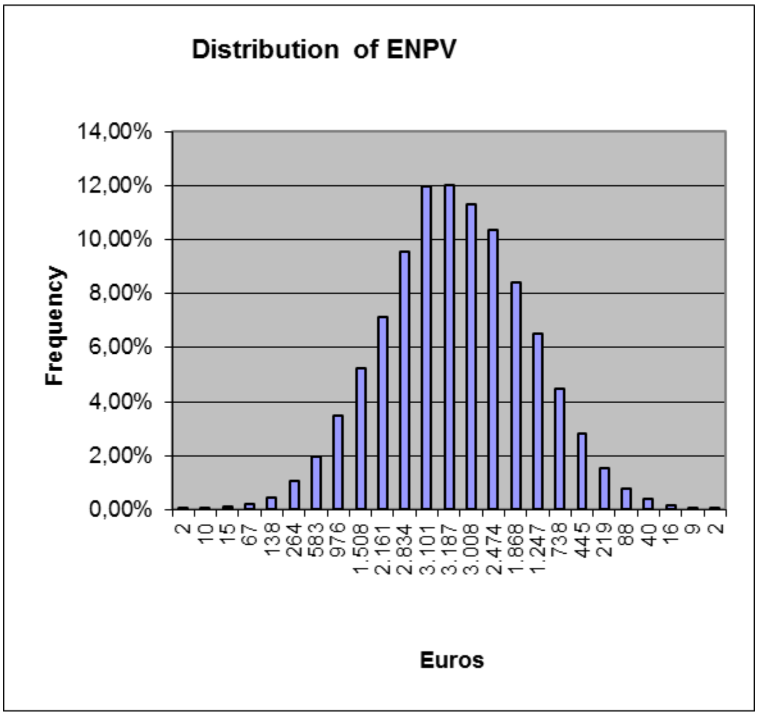


Figure 9-2: Distribution of ENPV values



Based on the distributions above:

- There is a 95% probability that FNPV/K is between -17041794,2 and -5256685,3, with a 00% probability of FNPV/K >0.
- There is a 95% probability that ENPV is between 2930240,8 and 13982444,9, with a 100% probability of ENPV >0.

Concluding the results of risk assessment, the project has very high possibility (almost certainty) to be constructed and operated with low risk in financial and economic terms, as are requested by EU co-funding regulations.

9.3.4. QUALITATIVE RISK ANALYSIS

Based on the results of the sensitivity analysis and taking into account uncertainties related to the aspects not directly reflected in CBA calculations, a risk matrix was prepared in order to identify possible risks prevention and mitigation measures.

The level of risk determined from the matrix identifies the level of control measures required for that environmental aspect.

Table 9-30: Risk Assessment Matrix

Probability \ Severity	I	II	III	IV	V
A	Low	Low	Low	Low	Moderate
B	Low	Low	Moderate	Moderate	High
C	Low	Moderate	Moderate	High	High
D	Low	Moderate	High	Very High	Very High
E	Moderate	High	Very High	Very High	Very High

Risk level	Colour
Low	
Moderate	
High	
Unacceptable	

Source: Guide to cost benefit analysis of investment projects 2014-2020

Explanatory notes on the selection of the Severity and Probability for each issue are presented in the following table.

Table 9-31: Risk Matrix Explanation

Probability			Severity		
A	Very unlikely	0-10%	I	Insignificant	No relevant effect on social welfare, even without remedial actions
B	Unlikely	10-33%	II	Minor	Minor loss of the social welfare generated by the project, minimally affecting the project long run effects. However, remedial or corrective actions needed
C	About as likely as not	33-66%	III	Moderate	Social welfare loss generated by the project, mostly financial damage, even in the medium-long run. Remedial actions may correct the problem
D	Likely	66-90%	IV	Critical	High social welfare loss generated by the project: the occurrence of the risk causes a loss of the primary functions of the project. Remedial actions, even large

Probability			Severity		
					in scope, are not enough to avoid serious damage
E	Very likely	90-100%	V	Catastrophic	Project failure that may result in serious or even total loss of the project functions. Main project effects in the medium-long term do not materialize

Source: Guide to cost benefit analysis of investment projects 2014-2020

The next table illustrates the Risk Assessment Matrix Results for the Waste Management System that will be constructed and operated in Skopje region.

Table 9-32: Risk Assessment Matrix Results

Risk description	Responsible authority	Authority for cooperation	Probability (P)	Severity (S)	Risk level (=P*S)	Risk prevention / mitigation measures	Residual risk after prevention/ mitigation measures
Delays related to the institutional set up of the project	MoEPP responsibility	Mayors and PUC	B	IV	Moderate	Ensure that there will be regular cooperation between the Municipalities, PUEs and IWMC at an early stage of project development (at least before the commissioning period of the project) so as to identify and address any issues in a timely manner.	Moderate
	MoEPP responsibility	Mayors and PUC				Agreements should be signed promptly between all stakeholders. The agreements will allow sharing the responsibilities between the involved parties.	
	Mayors	MoEPP				Establishment of the Regional WM boards	

Risk description	Responsible authority	Authority for cooperation	Probability (P)	Severity (S)	Risk level (=P*S)	Risk prevention / mitigation measures	Residual risk after prevention/ mitigation measures
	Mayors	MoEPP				Establishment of RWM Centers	
	Mayors and municipal councils	MoEPP				Centers should have sufficient staff, capacity.	
	Mayors and municipal councilsor any other possible involved entity					The level of tariff should have been agreed and the municipalities should verify their contribution by including these expenses in its future budget or any other possible involved entity should act accordingly	
	MoEPP	Mayors and PUCs				Ensure that there will be regular cooperation between the Municipalities and PUEs concerning the trans -municipal cooperation for the collection and transportation of recyclables and green waste.	
Lack of funds	MoEPP		B	IV	Moderate	The project promoter ensures that there will be regular cooperation with the managing authority in order to find funds and donors for the implementation of the project.	Moderate

Risk description	Probability (P)	Severity (S)	Risk level (=P*S)	Risk prevention / mitigation measures	Residual risk after prevention/ mitigation measures
Demand risks					
Waste generation lower than predicted	B	III	Moderate	• Demand analysis is carried out based on waste measurements and conservative assumptions on waste generation in the project area which are comparable with assumptions made in other regions in the country.	LOW
Waste flow control/delivery insufficient	B	III	Moderate	PUEs participating in the project control the waste flow within their collection zones in order to ensure sufficient delivery to the plant. The operating hours can be extended or reduced in case of seasonal fluctuations in waste input.	LOW
Design risks					
Inadequate surveys and investigation	A	III	Low	• Necessary surveys are undertaken during design. • The local conditions of the site have been considered during the elaboration of design.	Low
Choice of unsuitable technology	A	III	Low	• Option analysis has been carried out and the best-available technology has been selected. • Technology has many references in similar EU plants.	Low
Inadequate design cost estimates	B	III	Moderate	• Investment cost estimates are comparable to cost experienced with similar projects implemented in the EU in the last years. • Consultations with equipment manufacturers were carried out to cross – check estimates with current market conditions. • Prices at local market have been considered • Investment cost contains an element of contingency to meet the first tranche of overrun (if any).	Low

Risk description	Probability (P)	Severity (S)	Risk level (=P*S)	Risk prevention / mitigation measures	Residual risk after prevention/ mitigation measures
Administrative and procurement risks					
Procedural delays	C	III	Moderat e	• Prepared detailed tendering documentation by experienced designers. • Introduce time contingencies in project planning by taking into account possible procurement delays (i.e. management of claims by competitors).	Low
Building or other permits	B	II	Low	• EIA documentation has been submitted and the procedure for EIA permit is ongoing. The revision of Detailed Design for Building Permit for RED FIDIC part of works is under preparation within the project. • All other permits required for the construction and operation of the project will be acquired by the Contractor.	Low
Utility approvals	B	II	Low	• The Beneficiary will ensure close cooperation with the local authorities at the stage of design in order to obtain all necessary approvals (power supply, water supply etc.).	Low
Construction risks					
Project cost overruns and delays in construction	B	II	Low	• Investment cost estimates are comparable to cost experienced with similar projects implemented in the EU in the last years. • Investment cost contains an element of contingency to meet the first tranche of overrun (if any). • Publication of contract notices in the needed extend will be made so as to ensure wider competition. • Close monitoring of cost relative to budget should be undertaken (at least quarterly) to allow management and mitigation of	Low

Risk description	Probability (P)	Severity (S)	Risk level (=P*S)	Risk prevention / mitigation measures	Residual risk after prevention/ mitigation measures
				any over-runs should such occur. • Possibilities for delays in construction will be minimized through well balanced tender dossier. Delays in construction due to unforeseeable reasons affect only the time of achievement of targets.	
Contractor related (bankruptcy)	A	II	Low	• Requirements concerning financial capacity of the candidates will be included in the tender documents. • Bank guarantees will be required.	Low
Lack of resources	C	III	Moderat e	• The sound maturation of the project and its self-sustainability are strengthening the possibility to ensure financing. • Besides the possibility of EU funds attractive resources may be attracted.	Low
Operational risks					
Maintenance and repair costs higher than predicted, accumulation of technical breakdowns	A	II	Low	• Maintenance and repair cost is a small percentage of the operation cost • Operating cost estimates compare well with costs experienced with similar projects in operation.	Low
Process outputs fail to meet quality targets	B	II	Low	Moreover in the TD it will be included Eligibility Criteria for the tenderers and Performance Guarantee Forms for processes, in order to safeguard quality requirements.	Low
Failure to meet limits of emissions produced by the facility (to air and/or water)	A	II	Low	• All necessary measures for the environmental protection have been considered in the EIA. • In the operation manual effective retrieving measures will be defined. • Training programs will be provided to the personnel	Low

Risk description	Probability (P)	Severity (S)	Risk level (=P*S)	Risk prevention / mitigation measures	Residual risk after prevention/ mitigation measures
Financial risks					
Tariff increases slower than predicted	B	III	Moderate	• Provisions for regular price adjustments for inflation will exist. • Institutional arrangements are foreseen in the legislation for securing adequate tariff changes • Tariffs are not allowed to exceed the affordability threshold	Low
Tariff collection lower than predicted	B	III	Moderate	• Institutional arrangements are foreseen in the legislation for securing adequate tariff collection • Tariffs are not allowed to exceed the affordability threshold	Moderate
Regulatory risks					
Changes of environmental requirements, economic and regulatory instruments	B	II	Low	• The EIA permit which is now under consultation has been elaborated taking into account all environmental acquis in force. • Since the Beneficiary country is a Pre Accession Country, no new Regulations are expected than the already transposed of EU legislation while any new regulation have reasonable transition stipulations.	Low
Other risks					
Public opposition	A	II	Low	• The location for TS have been proposed by the Municipalities. • During EIA consultation all needed clarifications will be provided.	Low

10.PROCUREMEMNT AND IMPLEMENTATION

10.1 PROCUREMENT STRATEGY

10.1.1 Intruduction

This chapter presents the options for the implementation of the works, supply and services contracts, which were identified in the Feasibility Study. The proposed strategy shall take into consideration the most representative elements of good practice and shall remain flexible enough to answer the national and international evolution. The strategy identifies the key elements, which must be observed in the procurement activity.

10.1.2 Definitions

A Project Implementation Plan is the program that defines the long, medium and short term activities that will take place in a specific period in order for an investment project to be implemented. The procurement plan describes the timing, budget and type of the procurement activities that will take place in order to fulfil the requirement of the project implementation plan.

The project Implementation Plan and the Procurement Plan are required when the decision for financing is reached, funding sources have been identified and to purchase works, equipment or services has been made. Procurement planning is used as an opportunity to evaluate/review the entire procurement process so that sound judgements and decision making will facilitate the success of the overall project.

The overall objective of a Procurement Plan is to document and inform project stakeholders about how the procurements will be planned, executed, and managed throughout the life of the project. This Procurement Plan should outline the specific actions necessary to execute the approved acquisition strategy. The Procurement Plan documents the approach to be taken for items such as the actual acquisition, contracting, and fiscal, legal, personnel considerations, etc. The Procurement Plan should also address any policy, process, regulatory, etc. necessary to comply with any other requirements related to the specific acquisition.

For the purposes of this document, the following basic terms and expressions have the following meanings:

- Action for the maturation of the project: relates specifically to the activities before tenders start.
- Implementation Plan for the tendering: covers the sequenced steps for implementing the specific measures identified as priority investments for financing under EU Funds, comprising a timeline and a detailed programme from completion of the tender documents through to final approval and payment of contractors for works contracts and the final Supervision report.
- Procurement Plan: relates specifically to the procurement cycle from preparation of Tender Documents for all defined project objectives and the associated works and supervision contracts, advertising of tenders for those contracts in the Official Journal of the EU (or elsewhere as appropriate), submission and evaluation of offers, awarding of contracts, mobilisation of contractors and execution of the works through to completion including hand-over of the works.

It is assumed that the implementation will start at year 2018. However, due to the fact that, due to the uncertainty of financing, the commencement year it is not safely known yet, for the procurement plan the first year of implementation, will be defined as year "n".

10.1.3 List of activities for the maturation of the project

Action for the maturation of the project relates specifically to the activities before tenders start:

- Regular cooperation with the managing authority in order to find funds and donors for the implementation of the project;
- Establishment of the Inter-municipal waste management enterprise (IWME);
- Establishment of the Regional WM boards
- Establishment of RWM Centres
- Agreements should be signed promptly between all stakeholders (Municipalities, PUEs, IWME, Regional Centre etc.). The agreements will allow sharing the responsibilities between the involved parties; Clarifying the roles and responsibilities, so that overlapping and duplication of efforts shall be avoided;
- The level of tariff should have been agreed and the municipalities should verify their contribution by including these expenses in its future budget or any other possible involved ;
- Regular cooperation between the Municipalities and PUEs concerning the trans -municipal cooperation for the collection and transportation of recyclables and green waste;
- Increasing the efficiency of the public personnel, via training and capacity building;

If the above list of priorities is not accomplished before the tendering phase, it has to be completed prior to the commissioning stage, the latest.

10.1.4 EU and Macedonian legislation on public procurement

The procurement for the solid waste sector projects must be made according to the requirements imposed by the relevant national legislation and the EU Directives in force. In December 2011 the Commission proposed the revision of Directives 2004/17/EC (procurement in the water, energy, transport and postal services sectors) and 2004/18/EC (public works, supply and service contracts), as well as the adoption of a directive on concession contracts. The directives were voted by the European Parliament on 15 January 2014 and adopted by the Council on 11 February 2014. Therefore, the procurement shall be made according to the following:

- Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors (repealing Directive 2004/17/EC)
- Directive 2014/24/EU on public procurement (repealing Directive 2004/18/EC)
- Regulation (EU) No 1336/2013amending Directives 2004/17/EC, 2004/18/EC and 2009/81/EC of the European Parliament and of the Council in respect of the application thresholds for the procedures for the awards of contract
- Law on Public Procurement (Official Gazette of the Republic of Macedonia no. 136/07)

The principles at the base of the public procurement contract awarding are:

- Non-discrimination
- Equal treatment

- Mutual acknowledgement
- Transparency
- Proportionality
- The efficient use of EU and National funds
- Taking responsibility

10.1.5 Principal procurement options and procedures

The basic principle governing the award of contracts is competitive tendering. The purposeistwofold:

- To ensure the transparency of operations
- To obtain the desired quality of services, supplies or works at the best possible price.

The different types of public procurement procedures regulated by the Republic of Macedonia include:

(a) '**Open procedures'** means those procedures whereby any interested economic operator may submit a tender.

(b) '**Restricted procedures'** means those procedures in which any economic operator may request to participate and whereby only those economic operators invited by the contracting authority may submit a tender.

(c) '**Competitive dialogue'** is a procedure in which any economic operator may request to participate and whereby the contracting authority conducts a dialogue with the candidates admitted to that procedure, with the aim of developing one or more suitable alternatives capable of meeting its requirements, and on the basis of which the candidates chosen are invited to tender.

(d) '**Negotiated procedures'** means those procedures whereby the contracting authorities consult the economic operators of their choice and negotiate the terms of contract with one or more of these.

10.2 TENDERING STRATEGY

10.2.1 Tender Process

Contracting authorities who wish to commence a procurement have an obligation to publish a prior information notice and a procurement notice in the Official Journal of the European Union. In the case of open procedures, the minimum time limits are set in the Directive. In particular, the stages for the Tender Process are as follows:

- Preparation of Tender Dossier with Employer Requirements/ Technical Specifications (Use of FIDIC Yellow Book is recommended)
- Notices and publication in Official Journal of the EU and any other media
- Provision of tender documents and clarifications to the interested parties
- Evaluation of Offers based on Award criteria
- Contract award
- Contract signing

The award of the procurement should be based on objective criteria. Two award criteria are applicable, "the lowest price" and "the most economically advantageous tender" criteria.

At present, the following thresholds apply in the case of public procurements for the estimated value excluding VAT (http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8624&lang =en&title=Changes-to-public-procurement-thresholds):

- **5.225.000 EURO** for public works procurements
- **135.000 EURO**, for public supply and service procurements awarded by contracting authorities which are listed as central government authorities
- **209.000 EURO**, for public supply and service procurements awarded by contracting authorities other than those listed in Annex IV of the Directive (not the present case)

Where contracts are subdivided in lots, the value of each lot shall be taken into account when calculating the overall threshold. They are divided between those for services (i.e. technical assistance, studies, provision of know-how and training), supplies (i.e., equipment and materials) and works (i.e. infrastructure and other engineering works). For the contracts that will be financed by national or local funds, national procurement rules will be applied. Note that projects must not be split artificially to circumvent the procurement thresholds.

Depending on the eventual financing institution of the tendering (eg. EU, national funds, IFIs etc) the procurement rules that will be followed should be adjusted accordingly.

Beside the aforementioned in case that a PPP procedure will be chosen, the tendering strategy may be customised (e.g. through competitive dialogue etc).

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10.2.2 Criteria for Grouping of Tenders

In order to define the criteria to group the tenders it should be considered the type of investments. In general, the investment can be grouped into three main categories:

- Facilities undergoing construction works (Transfer Stations)
- Services (Technical assistance - supervision of the work contracts, etc)
- Supplies (TS mobile equipment, bins, trucks)

The number or type of contracts to be awarded for each of the above categories shall be established according to the following criteria:

- the type of construction works and services to be procured
- number and location of construction works to be procured
- the timeframe for the completion of the works and services
- the value of the works or services to be procured
- expertise/ know-how available on the local market
- management capacity of the Contracting Authority

10.2.3 Supply and Service Contracts

Similarly, Supply and Service Contracts can be tendered using either the Open, Restricted or Competitively Negotiated procedure.

The service contract is envisaged to provide support to the Final Beneficiary and the PIU in the implementation stage. During this phase, the Beneficiary through the Project Implementation Unit (PIU) with the Consultant Supervisors, will manage and supervise the contracts by working closely with the contractors to ensure that contract requirements are met. The purpose is to ensure that the contractors, as well as the works or equipment delivered comply with the contract requirements.

10.3 PROCUREMENT PLAN

It is assumed that the implementation will start at year 2018. However, due to the fact that, due to the uncertainty of financing, the commencement year it is not safely known yet, for the procurement plan the first year of implementation, will be defined as year "n".

Four different contracts is recommended that should be implemented as follows:

10.3.1 Works Contracts

1.1. Works contract 1.1, International open tender: "Construction of waste Treatment Facilities for Skopje Region" according to "Red Book" type of Contract. The contract will not be divided to Lots.

No. 1.1 Works contract	
SUBJECT	**Construction of waste Treatment Facilities for Skopje Region**
Budget without VAT	**1,382,989€** without contingencies &VAT
Procedure	International open tender procedure "Design –Build type"
Award	11/n
Construction Completion	03/(n+2)
Test Run	1 month 04/(n+2)
Trial Operational Period	05/(n+2)-06/(n+2)
Defects and Notification Period (DNP) (12 months)	07/(n+2) –06/(n+3)

1.2. Works contract 1.2, International open tender: Closure, rehabilitation and aftercare of non-compliant landfills and dumpsites in SKOPJE REGION.

No. 1.2 Works contract	
SUBJECT	**Closure, rehabilitation and aftercare of non-compliant landfills and dumpsites in Skopje Region**
Budget without VAT	**6,886,594 €** without contingencies & VAT (*)
Procedure	International open tender procedure "RED Book" type of Contract"
Award	05/(n+2)
Construction Completion	04/(n+3))
Defects and Notification Period (DNP) (12 months)	05/(n+3) - 04/(n+4)

(*) Source: Detailed Design of Closure, rehabilitation and aftercare of non-compliant landfills and dumpsites in Skopje Region

10.3.2 Supply Contracts

Based on the “*Need assessments, market analyses with costs estimations and Technical Specifications (TSs) for supply of equipment for waste collection and transferring of waste Skopje Region*” report, it has been decided to group the equipment to three categories – Lots, namely:

1) **LOT 1:**Bins and containers for temporary storage of waste (including bins for home-composting)
2) **LOT 2:** Trucks for collection of waste
3) **LOT 3:** Equipment for transfer stations

2. Supply contract, International open tender: The tender will be divided in lots as follow:

Supply contract: Supply of equipment for waste collection and transferring of waste for Skopje Region	
LOT 1 **Budget** without VAT	Bins and containers for temporary storage of waste (including bins for home-composting) **2,600,893€** without VAT
LOT 2 **Budget** without VAT	Trucks for collection of waste **2,905,770€** without VAT
LOT 3 **Budget** without VAT	Equipment for transfer stations **1,470,864€** without VAT
Procedure	International open tender procedure
Award	09/(n+1)
Construction Completion	01/(n+2)

10.3.3 Service Contracts

3.1. Services contract 1, International open tender: Technical Assistance & Supervision during implementation & Public Awareness services.

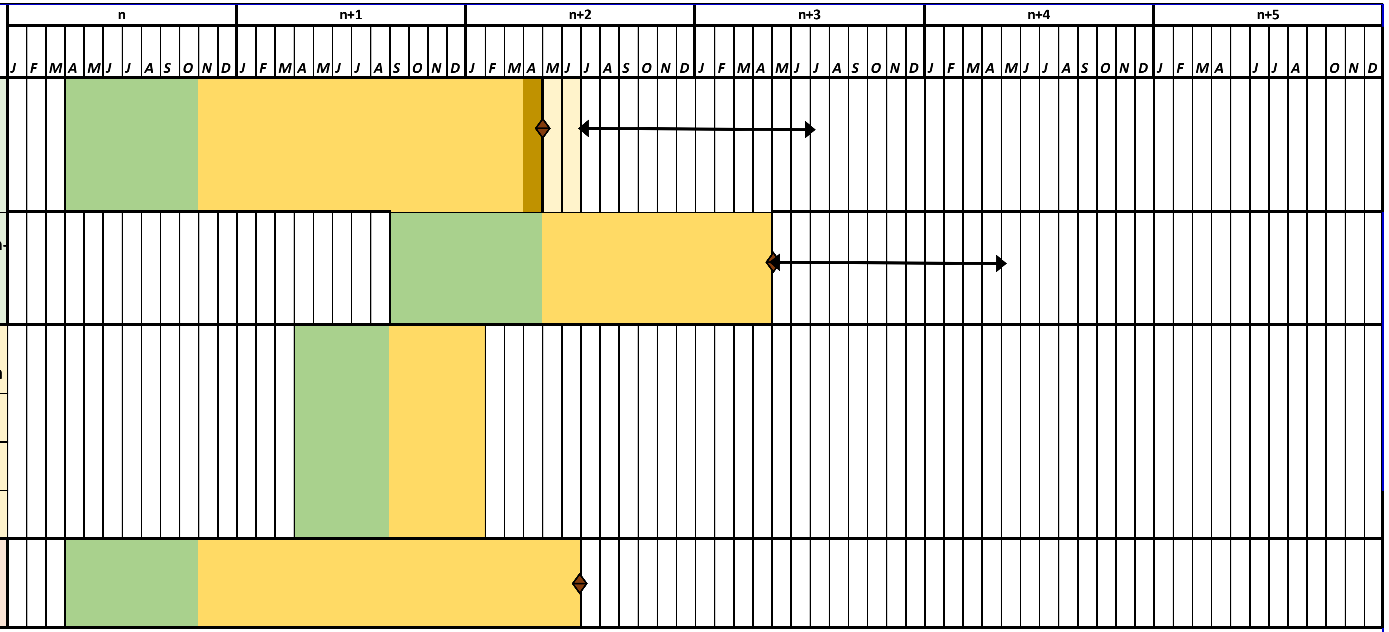
No.1 Service contract	
SUBJECT	**Technical Assistance & Supervision during implementation & Public Awareness services**
Budget without VAT	**670,000€** without VAT
Procedure	International open tender procedure
Award	11/n
Completion	06/(n+2)

10.4 IMPLEMENTATION PLAN

The following table illustrates the estimated timetable for the execution of the proposed works and services.

Table 10-1: Project implementation timetable

SUBJECT		
WORKS	1.1	Construction of waste Treatment Facilities for Skopje Region
WORKS	1.2	Closure, rehabilitation and aftercare of non-compliant landfills and dumpsites in Skopje Region
SUPPLIES	2.1	Supply of equipment for waste collection and transferring of waste for Skopje Region
SUPPLIES	Lot 1	Bins for temporary storage of waste
SUPPLIES	Lot 2	Trucks for collection of waste
SUPPLIES	Lot 3	Equipment for transfer stations
SERVICE	3.1	Technical Assistance - Supervision during implementation & Public Awareness service



TENDERING
EXECUTION
TEST RUN
COMPLETION
TRIAL OPERATION PERIOD
DNP